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November 1985
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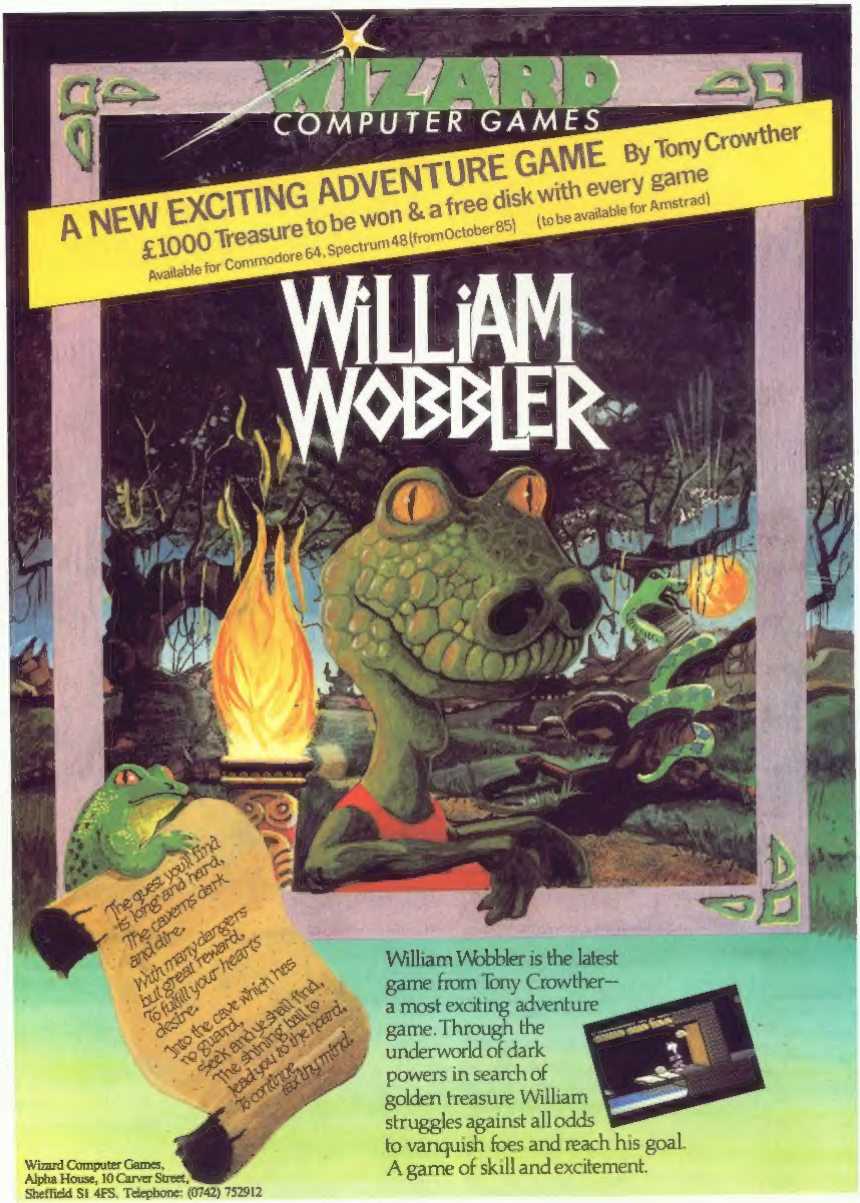
Summer Games II – Game of the month

Inside the 128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WILLIAM WOBBLER
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CONTENTS

FEATURES

SERIES

REGULARS

GAMES AND UTILITIES

COMPETITION

Editor:
Stuart Cooke

Assistant Editor:
Marie Curry

Advertisement Manager:
Mike Segrue

Advertisement Copy Control:
Laura Champion

Group Editor:
Dave Bradshaw

Group Managing Editor:
Wendy Palmer

Managing Director:
Peter Welham

Origination:
Ebony Typesetting

Design:
Argus Design

Editorial & Advertisement Office
No 1 Golden Square,
London W1R 3AB
Telephone: 01-437 0626
Telex: 8811896

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Our COMMENT

THIS MONTH, WE'RE DELIGHTED TO announce that Your Commodore has now joined forces with Your 64 to bring you the best Commodore magazine around.

Publishers of Your Commodore, Argus Specialist Publications, recently concluded the purchase of Your 64 from Sportscene Press. Peter Welham, ASP's MD, said: "This acquisition consolidates our position as one of the leading titles in the buoyant Commodore market and further confirms our commitment to machine specific titles."

We're pleased to welcome all our new readers to our pages and we can promise that you won't be disappointed. we're really going to have our work cut out over the next few months making sure we bring you only the best in software and hardware reviews, games and utility listings, plus many exciting and absorbing features for you to relish.

We're also very conscious of the fact that a magazine is nothing without its readers and so we'll be waiting anxiously for the postman every day to find out what you really think about our magazine.

Write to us at Your Commodore, No 1 Golden Square, London W1R 3AB and tell us what you think are the best (and worst!) features of the magazine and give us your ideas on what needs to be included. We promise to read everything you send so get those letters in the post now.

Stay with us over the next few months and we'll bring you the only Commodore magazine worth reading.

Stuart

DATA STATEMENTS

Part of Ariolasoft's new range

The sky's the limit

ARIOLASOFT'S RECENT SUCCESS, SKYfox, has now been released on cassette priced at £9.95. The game was originally only available on disk and the cassette version eventually released was the third attempt at maintaining the standard of Skyfox since two earlier conversions were rejected by the manufacturers as being not up to scratch.

Skyfox is only one of a number of new releases from Ariolasoft. The latest titles are Racing Destruction Set, Pinball Construction Set, Adventure Construction Set, Music Construction Set, Seven Cities of Gold and Mail Order Monsters. So far these titles are only available on disk and are all priced at £14.95.

Ariolasoft can be contacted at Suite 105/105 Asphalte House, Palace St, London SW1E 5HS.

Chatting up

COMPUNET IS DEVELOPING A NEW SERvice scheduled for a late autumn launch. It is a scrolling, CB style chat facility. The chat line will allow users to hold conversations in real time with other users all over the country.

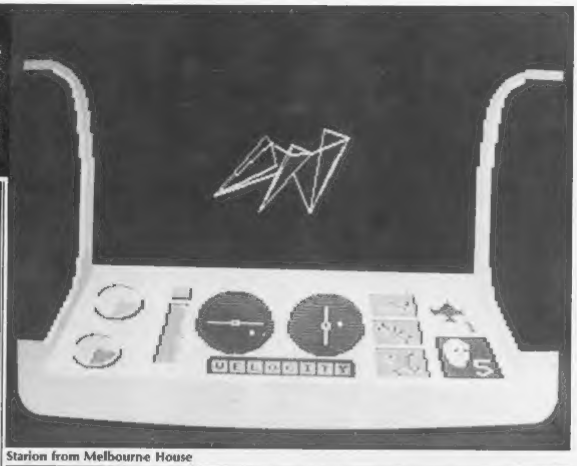
Contributions are typed into a window at the bottom of the screen while a second window above displays messages from other users. By scrolling back and forth the whole conversation can be reviewed. Users with similar interests can form groups by using individual chat lines which will be provided and those wanting a chat can monitor various conversations before deciding which one to join.

For further information contact: Compunet, Metford House, 15-18 Clipstone St, London W1P 7DF.

Starstruck

STARION FROM MELBOURNE HOUSE IS now available for the Commodore. It was originally released for the Spectrum and Amstrad computers.

The game will be priced at £9.95 and is obtainable from Melbourne House, Castle Yard House, Castle Yard, Richmond TW10 6TF.



Starion from Melbourne House

Beyond the fringe

BEYOND IS BRANCHING OUT WITH two new games.

The first is the computer version of Superman, a game developed as a joint venture with First Star. Bill Delaney, Beyond's MD said: "It will shoot to number one in every software chart."

Beyond has also formed a partnership with another software house, Nexus. The first game to appear on the new label will be called Nexus and will be a "sophisticated graphic adventure where the player becomes an investigative journalist infiltrating an evil drugs ring in South America.

According to Nexus, the game will offer maximum playability and user friendliness. Instead of having to read pages of documentation before starting, the player will be able to experience action straight away through on screen instructions. Nexus will also feature digitised video images which, it is claimed, will generate realistic animation enabling the player to recognise various characters.

Nexus costs £9.95 and is available from Beyond, Durrant House, 8 Herbal Hill, London EC1R 5EJ.

Gold standards

US Gold has brought out yet another batch of new releases. The three latest titles are Monster Trivia, Beach Head II and Ghostchaser.

Monster Trivia is a spin off from the enormously successful board game, Trivial Pursuits, but in this version you get killed by a monster if you get enough questions wrong.

Beach Head II is the follow-up to Beach Head and features multiscreen play, complex strategy, animation and high speed arcade action.

Ghostchaser takes Harry around Fairport Manor where he must blast large ghosts which materialise at random.

All the new titles are for the C64 on cassette or disk and cost £9.95 and £14.95 respectively. You can get in touch with US Gold at Unit 10, The Parkway Industrial Centre, Heneage St, Birmingham B7 4LY.

Feargal Sharkey sits up and takes notice

Vox pop

POP STAR, FEARGAL SHARKEY, HAS recently become the owner of the first production model of Supersoft's digital sampler for the C64.

He visited the Supersoft stand at the Commodore Computer Show and was very impressed with the sound reproduction quality of the new product.

The sampler is called Microvox and offers eight different sampling rates, up to a maximum of 42KHz which gives a 10KHz band width. Samples can be played forward or backward and there is full editing and looping with a high resolution display.

A 2000 note sequencer is included as part of the Microvox software with real time recording and step time editing.

Microvox costs £299.95 and is available through music shops, computer stores or direct from Supersoft at Winchester House, Canning Rd, Wealdstone, Middlesex HA3 7JS. A disc drive is essential.

Oh joy!

Jumping the gun

C-16 and Plus 4 owners can now pick up a bargain in Joysticks with Vulcan Electronics new packages.

The Gunshot I joystick is now being sold complete with an adaptor for £10.95. The packs are available from Dixons, Laskys and other computer retailers.

Everything the user needs to connect the joystick to his computer is included plus concise instructions and a 12 month guarantee slip.

For more information contact: Vulcan Electronics, 200 Brent St, Hendon, London NW4 1BH.

"I'll never have to feel like this again!"

Eye contact

SPECTACLE WEARERS WHO USE VDUs or television screens as a major part of their everyday lives can now try a new way of protecting themselves from eyestrain.

Balzars has come up with Quazar, a tough anti-reflection coating which, claim the makers, virtually eliminates lens surface reflections especially those caused by strong projected images. The coating can increase light transmission to almost 100 per cent.

The result for the user is that extra visual sharpness is noticeable during long periods of exposure, thus reducing visual fatigue.

For more information contact: Balzars, Northbridge Rd, Berkhamsted, Herts HP4 1EN.

Become a boffin

A NEW HOME COMPUTER TEACHING course has recently been released by Fearless Software. It is claimed that the course will take you from scratch to complete computer literally in 12 months.

Peter Ellis who formed the company to produce and market the Home Tutor said: "It is for children, housewives and the retired. It is also for those seeking new jobs or looking for promotion with their present employer."

The course is available on tape or disk and it teaches, demonstrates, corrects and tests the students. There is an examination at the end and those who pass receive a certificate.

The course starts by explaining what a computer is and goes on to teach Basic and machine code, covering such areas as information storage and communications. There are 13 parts to collect over the 12 month period.

Home Tutor costs £12.50 per month including tapes, teaching notes, a carrying case and ring binder. For disks the cost is £2 extra and postage is £1.15. Quarterly charges are £30 for tapes and £35.55 for disks.

For more information contact: Fearless Software, Infoplan, 30 Eastbourne Terrace, London W2.

Errata

A NUMBER OF PEOPLE SEEM TO BE having problems entering the Sketch Pad program which appeared in the September issue of Your Commodore. There are no errors in the program but some of the codes that our printer interface uses seem to be causing the problems.

In line 1450 the [255] is actually the character code for pi (π). This character is to be found on the key next to the RESTORE key. When entering the program you should type in the pi and not [255].

Another line that is causing problems is 620. It appears that in some issues of the magazine this has not reproduced very well. Line 620 should start with IF XC = 256 THEN

A number of people also seem to be having problems finding the ↑ character on their keyboard this is the up arrow ↑ to be found on the key next to the RESTORE key. The printer that we use does not print the downstroke of the arrow.

British Telecom and Program express sign up

The in-store terminal

Telecom deal

BRITISH TELECOM AND PROGRAM EXpress have joined forces to make the lives of software retailers and buyers less fraught with frustration.

Program Express is the firm which launched the Electronic Distribution of Software Machine in July 1984 which works on a "Central Computer Network/ In-store Satellite Terminal" principle. The retailer can download a unit of software from the in-store terminal onto a blank tape. The machine records all relevant details about the sale and at the same time new titles can be added to the hard disk terminal while old ones are deleted.

Under the new agreement British Telecom will finance the operation and Program Express's three directors, Gilmour Kennedy, Bruce Neville and Grant Robertson will run the company auutonomously.

INPUT

Agony Aunt Tony Crowther answers more of your programming questions.

INPUT

I have been told on many occasions that it is possible to make all of the keys on the C64 keyboard repeat, as on the Spectrum.

This seems to be a very handy facility as you could enter long strings of the same character without having to press the key for each letter.

However, I do have one slight problem, nowhere can I find mention of how to do this. Would it be possible to provide me with the necessary commands or program to make the C64's keys repeat?

Mike Atkinson
Taunton

OUTPUT

Yes, it is possible to make all of the keys on the C64 repeat and it is very easy to do. All you have to do is POKE into a few memory locations. The locations are as follows

Location	POKE	Result
650	255	all keys repeat
650	0	no keys repeat
650	128	just the cursors repeat
651	0-255	repeat speed
652	0-255	delay before repeat

The keyboard scan is done by the hardware IRQ interrupt, if we change the clock rate of timer A we can make the rate of the interrupts speed up or slow down. Try:

POKE 56325,number (0 to 255)

a number of zero to 10 forces many interrupts a second and causes the Basic run speed to slow down. This could be used to your advantage when debugging a Basic program as everything will slow down.

INPUT

I write to congratulate you on the quality of your magazine. I find it to be the best of the British Commodore mags available in Australia. However I feel that the atrocious reproduction of graphics symbols spoils it. I would suggest that you employ a system like the American magazine 'Ahoy', which permits rapid loading and clear understanding of listings.

P.Robinson,
Blackwater,
Australia.

I'm not sure what system Ahoy uses but we nevertheless accept that the listings need improving. Therefore we will be using a Micrografix MW350 in future, which replaces all graphic characters with a short description.

INPUT

I have a problem with my 64 that I cannot get an answer to. After about two hours my computer crashes, putting random graphics on the screen and eventually the whole screen is covered in flashing graphics If I turn it off for a couple of hours the problem goes away but it recurs more frequently afterwards.

L.Burn
South Shields
Tyne & Wear

OUTPUT

The problem is that your 64 is overheating I suggest that you take it back to the dealer and see if he can replace it.

INPUT

In your March issue you did a feature on Games creators and this article impressed me so much that I wish now to buy one. The one I am interested in is the Quill by Gillsoft, could you please tell me their address.

P. Vassallo
Pieta
Malta

OUTPUT

Gillsoft are at:-
30 Hawthorn Road,
Barry,
S. Glams.
CF6 8LE.

INPUT

In am writing a program in machine code that requires a lot of data storage. I understand that there is 8K of RAM 'underneath' the Basic Kernal. This would be an ideal place to store my data and machine code routines.

Could you please explain how I access this area of memory as when I try I only get the Basic ROM and not the numbers I have stored beneath it?

OUTPUT

As you have already found out you can't use the area of memory beneath the Basic Kernal when Basic is running as any peeks or calls to that area will just go to the kernal. If however you are using machine code you can turn off the Basic kernal and use the memory that sits beneath it quite easily.

First you must switch off the Basic ROM. To do this you unset the lower bit of memory location one. This can be done simply by subtracting one from it. If this action was to take place in Basic your program would crash. However, in machine code it will not affect the program.

If your machine code routine was to start at — or your data was stored at — location 40960 ($A000), then this small routine would allow you to access it.

```
$C000 DEC $01      ; switch off Basic ROM
$C002 JSR $A000    ; jump to start of
                     program
$C005 INC $01      ; back here from your
                     routine
; first turn Basic
                     back on
$C0006 RTS         ; return to Basic or rest
                     of program
```

OUTPUT

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- Know your Own IQ (cass.) ☐
- Patrick Moore's Astronomy (cass.) ☐

VIC 20

- Sargon II Chess (cart.) ☐
- Omega Race (cart.) ☐
- Road Race (cart.) ☐

COMMODORE 16/Plus 4

- Harbour Attack (cass.) ☐
- Space Sweep (cass.) ☐

I would like to receive a regular issue of Soft Post. I own a Commodore (delete as applicable): VIC 20/64/16/Plus 4.

Title (tick): Mr. ☐ Mrs. ☐ Miss ☐ Initials ☐☐☐☐ SO YCO 1110

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Address

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Fill in your name and address and your friend's below. Now you can choose one item from either list, just tick a box.

VIC 20

- Programmer's Reference Guide (book) ☐
- Introduction to BASIC II (cassette) ☐

COMMODORE 64

- Programmer's Reference Guide (book) ☐
- Fantasy Five (cassette) ☐

COMMODORE 16/Plus 4

- Jack Attack (cartridge) ☐

I would like to introduce my friend who owns a Commodore (delete as applicable): VIC 20/64/16/Plus 4.

Title (tick): Mr. ☐ Mrs. ☐ Miss ☐ Initials ☐☐☐☐

Surname

Address

Postcode

STD. Code Telephone

ONLY ONE APPLICATION PER HOUSEHOLD.
PLEASE ALLOW 28 DAYS FOR DELIVERY.

Post to: SOFT POST, FREEPOST, Commodore Business Machines (U.K) Ltd., Corby, Northamptonshire NN17 1BR.

THE C128 -IN DEPTH

Stuart Cooke has spent hours slaving over a red hot Commodore 128 and he's decided that it was definitely worth the effort.

COMMODORE ARE ALL SET to prove that three into one does go with their new Commodore 128 computer.

The C128 is essentially three computers in one. Inside a case that looks as though it would be quite at home on the flight deck of some futuristic spaceship there is a good old C64. Secondly we have what can only be described as an upgrade of the C64, 128 mode. Hardware-wise this is the same as the C64 with only a few changes. Thirdly there is a machine that has also been around for quite a long time, but not from Commodore. This is a CP/M computer. CP/M has been around for a number of years and is the name given to an operating system that is used on some Z80 based business systems to allow a great deal of compatibility between manufacturers. Perhaps one of the most famous business packages that runs under CP/M is the word-processing package Wordstar which is in use in thousands of offices around the world.

First Impressions

The first thing that you notice about the C128 is that you are not getting some fantastic new machine for your money. What you do get are two very well established machines and one very good up grade.

The machine itself has been designed to achieve as much compatibility as possible with the C64 and other Commodore products. For this reason many of the expansion connectors will be familiar to owners of other Commodore machines. There are connectors on the machine for two joysticks, Commodore's own serial peripheral connector, TV interface, composite video interface, a standard Commodore cassette interface, a user port and a cartridge port. New items obvious on the sides of the machine are a reset switch and a RGB monitor interface.

Even though Commodore has tried to make the C128 as compatible as possible with the C64, the cassette interface is in a silly position. If you plug a Commodore modem into the cartridge port the casing of the modem obscures the cassette interface preventing a cassette recorder from being plugged in.

The keyboard bears only a slight resemblance to earlier Commodore machines as there are more keys available. Added keys include a numeric keypad and a large number of function keys.

In Use

When powering up you are able to decide whether you wish to boot up the C128 in 40 or 80 columns, CP/M, 128 or 64 modes. Here we come across the first problem with the C128. The 80 column display can only be viewed on a monitor that is plugged into the RGB interface while the 40 column display can only be viewed on a TV or monitor plugged into the composite video socket. If you wish to use both 40 and 80 columns then you will need two different monitors. Commodore has produced a new monitor that will allow you to switch between the two modes of operation. A monochrome composite signal is present on the RGB socket so you can plug a monochrome monitor to view 80 columns if you already own one. Using a monochrome monitor will not cause any problems especially when you realise that the 80 column mode is text only and no graphics are available.

C64 mode offers nothing new, what it does do however is allow you to use all of the packages that are currently available for the C64 on your C128 computer. This is great news for people who already own C64s and are thinking about upgrading. Over 100 pieces of software were tried on the review machine and all of them worked correctly. The only problem that we found was with programs that used keyboard overlays as the keys are in different positions. This is especially noticeable with Commodores Music Maker package as the keyboard will not fit the new design. Even so it appears that all problems will work with no faults.

An on board Z80 micro processor allows you to run CP/M Plus version 3.0. CP/M Plus will give your CP/M programs full access to the 128K of RAM that is built into the machine as standard. Commodore has made a few changes to CP/M Plus, mostly by adding some new com-

mands. Because of this total, CP/M compatability is something that will have to be proved. Unfortunately the review machine did not come with any CP/M software so this was something that I was unable to test.

As I have already mentioned, 128 mode offers nothing very new apart from an excellent Basic and an 80 column display. Basic 7.0 can only be described as the Basic that should have been implemented on the C64 as it allows total control of all the facilities offered by the hardware without having to resort to POKEs or machine code.

The new disc drive is also a great improvement on the old 1541 when used in C128 or CP/M mode as it will LOAD and SAVE programs around three to four times faster – a great relief to anyone who has used a 1541. Unfortunately, when used in C64 mode the drive works at the same slow speed that we all know and hate.

Basic 7.0

Basic 7.0 contains a large number of commands that are designed to ease the use of sound and graphics together with a large number of 'toolkit' commands. For example the AUTO command will automatically give line numbers. BLOAD and BSAVE allow you to load* and save specific sections of memory. A renumber function helps with the development of long programs. Programs that do not work correctly are easier to debug with the HELP command which will show you where your error has occurred or the TRON and TROFF commands which will display the line number of the line that is about to be executed.

Error trapping is provided by the TRAP command. Whenever an error is detected this command will cause the program to jump to the specified program line rather than 'bombing out'. You will then be able to find out what error has occurred and take the appropriate action. This command will make idiot-proofing your Basic programs very easy.

Finding out what the controllers are doing is also made very easy. JOY will tell you which direction a specified joystick is pointing in and whether the fire button is pressed. The position of the paddles and light pen is also easy to find out with the POT and PEN commands respectively.

Machine code buffs will be pleased to hear that a machine code monitor is included. This will allow you to display, alter and move sections of memory. There is even a machine code assembler and disassembler. The Basic keywords HEX$ and DEC will also prove to be very handy as they will allow you to convert decimal numbers to hex and vice-versa.

A number of new structure commands have been added to the standard FOR/NEXT loop. These include DO/LOOP which will repeat a section of your Basic program UNTIL a specific condition is met or WHILE a specific condition is met. IF/THEN will only allow one statement after the THEN instruction, BEGIN/BEND will allow a number of program lines to be included after a THEN statement.

Graphics

Budding artists are well catered for inside Basic 7.0 by a large number of graphic commands. GRAPHIC is used to turn on one of the six different graphics modes that are available. The six modes are, 40 column text, standard bit-map graphics, standard bit-map with split screen, multi-colour with split screen and 80 column text. As previously mentioned the 80 column screen can only be used with a monitor plugged into the RGB socket. The split screen modes are very interesting as they allow you to use a section of the screen in one of the graphic modes while still retaining a specified segment for text only. This type of feature has been used many times on the C64, especially in graphic adventures, but is now extremely easy to use on the C128.

Drawing lines or shapes on a graphic screen is also very simple. The COLOR command allows you to set up the colours that you require for any plotting etc. The LOCATE command can be used to position the graphics cursor at any point on the screen, and

DRAW will allow you to plot dots or draw lines in the specified colour. Shapes can easily be drawn as the draw command will allow you to string a number of points together by using the word TO as in

DRAW 100,100 TO 10,100 TO 10,10

BOX makes it extremely easy to draw rectangular shapes on the screen, all that is necessary is to specify the top right hand and bottom left hand co-ordinates together with the rotation of the box. You can even specify if you want the box to be filled in with a certain colour.

CIRCLE is used to draw circles, ellipses and 'other' shapes. This may seem to be a weird statement but when you see how complex the circle command can be you will understand what I mean. The CIRCLE command can have up to nine parameters, these are, the colour source, the centre of the circle, the X radius, the Y radius, the starting arc angle, the ending arc angle, the rotation in clockwise degrees and the number of degrees between segments. This does appear very complicated at first glance but playing around with the parameters will soon show you how versatile this command really is. Not all of the parameters need to be used every time that the command is used. The following example is from the manual and will draw a diamond shape on the screen.

CIRCLE 1,260,40,20,30,,,,90

WIDTH can be used to set the width of any lines that you are drawing while SCALE will allow you to alter the size of your diagrams with ease. Another handy command is PAINT which will allow you to fill in any area of the screen with a specified colour.

A very limited form of window is implemented on the C128 through the WINDOW command. This allows you to set up a rectangular area on the screen in which all further screen updates will occur. The size of this rectangle can also be set up outside a program by using ESC T to set the top left corner and ESC B for the bottom corner.

As well as having commands for producing pictures on the screen, there are also a few that will tell you exactly what is happening on your display. The RGR will tell you which graphic mode the C128 is in at the moment. RDOT returns the current position of the graphic cursor or the colour of the graphic cursor. You can even find out the window parameters by means of the RWINDOW command.

SPRITES

As with the C64 there are eight sprites available for use on the C128. These can be either hi-res one colour, or multi-colour. However, unlike the C64, you'll never have to perform a single POKE to memory as Basic 7.0 supplies all of the commands that you'll ever need. You don't even need a sprite editor as there is one built into Basic.

SPRDEF is the command that turns on the C128's sprite editor. On entering the command the screen clears and a sprite grid is displayed on the screen. Facilities available in the editor are, turning on and off multicolour mode, changing the colours, expansion of the sprite in X and Y directions, copying sprites and saving sprites. In fact all of the commands that you are likely to need are implemented. One fairly major omission from the sprite editor is the ability to move the sprite around in the grid. You cannot, for example, rotate a sprite or shift it left by one pixel. No doubt someone will develop a routine to perform these commands.

Another way of defining a sprite is to 'draw' the sprite onto the screen using the many drawing commands. The SSHAPE command can then read the sprite data into a string variable. Moving the contents of this string into sprite memory is also made very easy by the SPRSAV command, this moves the specified string into the sprite not required.

The SPRITE command allows you to turn on and off the individual sprites. SPRITE also lets you set the sprite colour, whether it passes over or beneath the background, whether it is hi-res or multicolour and if it is expanded in either the X or Y directions.

Moving a sprite around is also made child's play with the MOVSPR command. MOVSPR can take a number of forms. It can place a sprite at a specified point on the screen. It can be used to move a sprite to a new position relative to its old one, move a sprite a certain distance at a specified angle and, perhaps its most powerful use, it can set a sprite moving in a specified direction at specified speed and keep it moving. As you can probably see, the MOVSPR command will be a great boon to anyone who wishes to write a game program. Moving your latest deadly creation across the screen can now be done by one command rather than the numerous lines of code that C64 users are used to.

Looking after your sprites is no longer a problem as the COLLISION command will cause a jump to a specified line number when a sprite hits the background or another sprite. The BUMP command can then be used to return the values of any sprites that have collided since the last BUMP command.

Finding out the specific details of any sprite is also made easy with a number of commands. RSPCOLOUR returns the colour of a specified sprite. RSPOS will return the X, Y co-ordinates of a sprite, very handy after a BUMP instruction, and RSPRITE will tell you whether a sprite is on, off, expanded etc.

As you can no doubt see from the brief mention of the sprite manipulation commands that are mentioned above, writing any sort of program that uses sprites is now extremely simple. Before very long we should start to see some excellent graphic programs written totally in Basic.

Sound

The sound chip that is used in 128 mode is exactly the same as in the C64, the major difference being that there are now a large number of commands available to make control of it easy. There are five commands available for sound manipulation. SOUND is used to place quick and easy sound effects in your programs. SOUND can have up to eight parameters. These are, the voice number (one to three), the frequency of the note, the duration of the note, whether the sound is to be incremented or decremented while playing, the minimum frequency the note can go to, how big the step up or down is, the type of waveform to use and the pulse width if you are using a square wave. As you can see, some very interesting effects can be made by using this command. Another command is designed to make the playing of music easy, this is the PLAY statement. PLAY allows you to set up a string of synthesiser control characters inside quotes. Characters allowed are the musical notes ABCDEFG, characters which tell the synthesiser what type of note is playing and characters to specify the voice octave, envelope volume and filter. Ten predefined envelopes are available ranging from harpsichord to xylophone and you are able to define your own using the ENVELOPE command. TEMPO defines the speed of the song being played and VOL the volume. The command FILTER will also let you set up the filters parameters very easily.

Adding a musical accompaniment and sound effects to your programs is now very easy. Even a beginner will soon be producing sounds that are the same quality as those that the top programmers have been producing on the C64.

Verdict

Obviously I have not been able to cover all of the details of the C128 and its Basic, there are many commands that I have not covered. However, from the few that I have mentioned I think it should be fairly obvious that the C128 is a powerful machine, or should I say machines? The fact that it will run all C64 software, and that thousands of business packages are available with CP/M, make the machine a bargain for the beginner, hobbyist and businessman alike.

Commodore seems to have a winner.

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Language Lab P·A·S·C·A·L

Our resident linguist, David Janda, gives you a breakdown of Pascal packages for the C64.

PASCAL WAS INVENTED BY ONE MAN Niklaus Wirth of the ETH Technical Institute of Zurich in 1970. It is a compiled language that was designed as an aid to teaching good programming practice.

Because the language is very concise, institutions found it easy to implement on their systems. Software houses also discovered that it was possible to implement Pascal on many home micros, hence the reason for its early appearance on the micro scene.

Program Body

Unlike Basic, where you have a free hand in program structure, Pascal requires the programmer to 'section' his programs. There are three main sections to a Pascal program.

```
PROGRAM - header declarations
BEGIN - Main body
END
```

The first section is the program header. Every Pascal program must start with the reserved word 'PROGRAM', which is followed by the name of the program. This can be optionally followed by I/O declarations, implemented in various ways in different compilers.

The next section is the declarations. There are a number of these. First there is the reserved word 'CONST', used to define a symbolic constant.

```
CONST
  PI= 14159
  AGE=23,
```

In the example, two constants have been declared. Following the constant declarations, come the more common variable declarations.

```
VAR
  PI  : REAL
  SUM,WEIGHT,TOTAL  INTEGER
  SWICH : BOOLEAN ,
  INITIAL  CHAR,
```

The four data types are integer, real, string and boolean. Pascal requires all variables to be declared explicitly. For Basic programmers this may come as a bit of a shock. It's very easy in Basic to declare yet another variable as you need it, but in Pascal this is not the case. The good point in declaring variables is that you need to do some thinking and plan on how many variables you will need in the first place!

The next declaration is probably one of the most powerful features of Pascal – type definition. As you can see from above, there are four data types in Pascal. These are pre-defined data types, and if you wish you can declare more.

```
TYPE
  DAY =(SUNDAY, MONDAY, TUESDAY,
WEDNESDAY, THURSDAY, FRIDAY
SATURDAY),
```

To make this a little clearer imagine the following.

```
TYPE
  INTEGER=(1,2,3,4, .... . 65534,65535),
```

In other words, defining your own data type is a convenient means of giving a name to an ordered sequence of known elements. To add the icing to the cake, a SET can be declared which is a collection of objects of the same type.

```
TYPE
  CAPS=SET OF 'A..Z',
```

Now we can have the following in a VAR list.

```
VAR
  LETTER : CAPS
```

The last two items in the declarations section of a Pascal program are procedures and functions. Basically, a procedure is a sub-program (a sort of subroutine), which contains other statements and so on. Functions are a means of declaring new operations that Pascal does not have.

So far, the main program body has not been discussed. As you might have already guessed, Pascal programming requires a lot of thought. This is a good thing because people tend to program at the keyboard without thinking first. Thinking about what data types and variables you'll need will encourage thought, and a good program can be the final result.

Pascal Syntax

The third section in a Pascal program is the main body of the program. Here, the first and last reserved words are BEGIN and END with the final END followed by a full stop. I say 'final' because there are normally more than one set. To understand this better, here is a very simple Pascal program.

```
PROGRAM Greeting,
BEGIN
  WRITELN( Hello  Your  Commodore
readers!',
END
```

Notice that there is no declaration section. The two statements in our small example are the first line and WRITELN. Statements are separated by a semi-colon. The exception to this case is the statement preceding and END.

```
PROGRAM Greeting
BEGIN
  WRITELN('Hello')
  WRITELN( How are you today? )
END
```

In the example, the first statement after BEGIN ends with a semi-colon because the next line contains another statement. Now look at this example.

```
PROGRAM Count
VAR
  I : INTEGER
BEGIN
  WRITELN ('Watch this!'),
  FOR I =1 TO 10 DO
    WRITELN('Ying )
END
```

This simply prints 'Watch this' followed by 'Ying' printed 10 times. However if I wanted to print 'Ying' followed by 'Yang' on the next line a nested BEGIN END has to be used.

```
PROGRAM YingYang
VAR
  I  INTEGER
BEGIN
  WRITELN('Watch this!'),
  FOR I  =1 TO 10 DO
    BEGIN
      WRITELN( Ying ),
      WRITELN('Yang'
    END,
WRITELN('That's all folks.')
END
```

The two statements between the second BEGIN END are considered as a compound statement i.e. treated as one. This example also demonstrates the use of identation. This is NOT compulsary, but it does make the program easier to read and

follow through logically. The normal rule of thumb is that when nesting occurs (more BEGINs) you indent, and as the END is matched on the same column indentation occurs.

```
BEGIN
  statements
  BEGIN
    statements
    BEGIN
      statements
    END
  END
END
```

Procedures and Functions

Tables one and two list the standard Pascal reserved words as well as pre-defined procedures and functions. There are not many, but they are pretty powerful. Pascal provides the features to define your own procedures and functions made up from existing procedures and functions.

In essence, procedures and functions are mini-programs. They may have their own declarations and program blocks, just like the main program. Although similar, there are a couple of differences between the two. Procedures do not have to have a parameter passed to them, although it is possible to pass parameters to and from procedures. Functions on the other hand, must have a parameter and can be used in comparisons whilst procedures cannot.

Here is an example of a program that uses a procedure. All it does is print the numbers one to 10, 10 times.

```
PROGRAM Test,
VAR
  I , INTEGER,
  PROCEDURE Count
  VAR
    I : INTEGER,
  BEGIN
    FOR I =1 TO 10 DO
      WRITE(I)
  END,
BEGIN
  FOR I =1 TO 10 DO
    Count
END
```

Notice that the procedure and the main program use a variable with the same name. This is OK, because variables are local to procedures and functions. Also note that the procedure 'Count' is called from the main program just like any other procedure (no line numbers like Basic!).

A function is declared in a similar manner, although its operation is different.

```
PROGRAM Table
VAR
  I : INTEGER
  FUNCTION Square (N : INTEGER
  INTEGER
  BEGIN
    N =N*N
  END,
BEGIN
  FOR I =1 TO 10 DO
    BEGIN
      WRITE(I),
      WRITELN(Square I))
    END,
END
```

In the example, I have used the function 'Square' directly, but as with normal functions it is possible to pass the result to a variable.

Control Structures

Commodore Basic is a bit limited as far as control structures are concerned. Pascal on the other hand, offers the programmer some very elegant means of controlling program flow.

One control structure which has already been covered in the examples is the FOR..DO loop, which is similar to the Basic FOR..NEXT.

```
FOR I =1 TO 10 DO
  WRITELN (I),
```

DOWNTO is used to reverse the loop.

```
FOR I =10 TO 1 DO
  WRITELN (I),
```

To include more than one statement with in the loop boundaries, a compound statement is used.

```
FOR I :=1 TO 20 DO
  BEGIN
    Statement,
    Statement,
    .
    .
    .
    Statement
  END,
```

One last point about a FOR..DO loop is that unlike Basic, Pascal does not like the index (the variable after the FOR) to be altered within the loop itself.

Probably the major drawback with the FOR..DO type of loop is that you have to specify an end to the loop. That is, a FOR..DO loop must have fixed boundaries – even if passed by variables. Pascal offers a couple more control structures which are more flexible.

The first of these flexible control structures is REPEAT..UNTIL.

```
REPEAT
  A := A+1
  WRITELN(A)
UNTIL A = 10
```

Notice that A would have been initialised before entering the REPEAT loop. Also note that compound statements do not have to be used. Instead, statements are merely separated by the semi-colon. Can you see why this is the case?

You can see from the example that a boolean test is performed after the UNTIL. Any of the boolean operators can be used in this test including '<', '>' and so on. The most important point worth remembering about the REPEAT..UNTIL loop is that the statement(s) within it will be performed at least once. This is because the test is done at the end of the loop.

The second 'ever-so-flexible' control structure is the WHILE..DO loop which takes the following form.

```
WHILE level desirable DO
  BEGIN
    level =level+1
    mix
  END,
```

Notice that the boolean test is performed before any statements are executed so that if the boolean test is false no statement will be executed. A final point to note is that unlike the REPEAT..UNTIL loop, multiple statements must be treated as compound statements i.e. with a BEGIN..END.

The final control structure to be considered is the CASE statement. This is used in situations where the number of alternatives is greater than two. It is best understood by example.

```
CASE month OF
    1 WRITELN('January'),
    2 WRITELN('February')
    3 WRITELN('March')
   12 WRITELN('December')
END
```

In the example the variable 'month' has a certain value. Depending on what that value is, perform a different action. That is exactly what the CASE statement does. If 'month' is equal to five then 'May' will be printed, and so on.

Oxford Pascal
Oxford Computer Systems
Disk

Not all compilers produce native machine code, some produce what is known as P-code. The version of Pascal from Oxford Computer Systems does just that. The result is an executable program that doesn't run very fast. However, it should be noted that there are numerous Pascal P-code compilers because they are easy to implement.

Although Oxford Pascal is quite expensive, you do get a lot for your money. First, it follows the Pascal standard almost to the letter. Because of this it

could be used as a serious Pascal training tool

A major problem with disk based compilers is the time it takes from writing the program to running it! Because of this Oxford Pascal offers two methods of running Pascal programs

The first method is to use the resident compiler. This is the default option when the compiler is first loaded. In this mode it is possible to write, amend, compile and run a Pascal program without having to access the disk drive. This allows learners to get their feet wet and generally muck about

The second method of operation is disk mode. Here, a program has to be developed in the standard method. That is, entered, saved to disk, compiled and re-edited if any errors occur. This mode does offer numerous advantages though. Programs can be much larger as compilation is from disk. Other advantages include data file handling, the availability of the full compiler syntax, external procedures and so on. Object code can also be converted to run as stand a one code

Machine dependant features include a form of peek and poke, colour and sound and some graphic commands. Most notable of these is the window command that allows the screen to be split between the high-resolution graphic screen and the text screen

Pascal 64
Orpheus Ltd
Tape

Pascal 64 and Oxford Pascal are so similar in many ways that most of the comments in these reviews apply to both packages

As with Oxford Pascal, Pascal 64 offers an almost complete definition of Pascal as defined in the User Manual and Report by Wirth & Jensen. It is however, a cassette version and does not produce stand alone code (i.e. does not have a disk mode)

The Pascal source is entered in an editor which is very similar to the standard C64 editor

There are a few differences and additions. Namely, source code can be entered with indentation, thus showing the program structure. Additions to the standard editor include commands such as search and replace, auto line numbering, renumber, delete and so on

The source program can be compiled with or without a listing, which can be directed to the printer. The object code can then be run and/or saved to tape. But as stand alone programs cannot be produced, it is necessary to have the compiler in memory when running any object code

Additions to the standard are similar to what Oxford Pascal offers. But the general purpose DRAW command in Pascal 64 is much faster (see benchtests). Additional features include sprite handling, the ability to read a light-pen and the joystick ports

Both Oxford Pascal and Pascal 64 have common faults. Firstly, both packages are slow (see benchtests). In fact neither of the two compilers is that much faster than Basic. This is a great pity as one of the advantages of Pascal is its speed

Other problems include flickering of the high-resolution graphics screen. But the biggest fault is that this screen is divided into 250 by 200 pixels, why not the full 320?

Pascal 64
First Software
Disk

When I first heard about this package I thought, "Great, a true Pascal compiler." However, after using it I have mixed feelings; it's both very good and really awful

The package consists of a disk and 70m page poorly written manual/user guide. The software was written by a German company called Data Becker and the text of the manual and software have suffered through translation!

The compiler is very disk intensive and takes about three stages before a program can be run. The tasks involved in developing a program with this package are, write the source, compile the source, link the object code and save object code to disk. On the good side the compiler produces compact stand-alone code, but don't expect to achieve that in five minutes.

The biggest let-down with this package is the first stage of producing a program. There is no editor and it is necessary to enter the source code using the standard editor. Not only is this a bother (there are no extra editing commands), but it is a disaster. The reason for this is simple. Part of the 'beauty' of Pascal is the ability to write programs that are indented. This makes the program look neater, easier to read and identify. Because Pascal 64 requires the source to be entered using the standard '64 editor no indentation is allowed (unless spaces are preceding by a ',' which makes the source look ugly!)

Another weird thing about the package is that all Pascal keywords must be followed by a space character. This is non standard, and the more experienced programmer will be frustrated by this whilst the beginner will pick up a bad habit. Why a space is required, is beyond me

Although the review so far has been negative, things get better after the source has been entered. Once the code has been compiled and linked a machine code file is produced and can be run stand-alone

The compiler itself is the best of the three packages reviewed, offering more advanced features. These include comprehensive file handling, external procedure support, high-resolution plot, sprite command etc

An integer command enables faster execution if only integers are being handled. Another impressive feature is the ability to run a procedure as an interrupt. The constraints on this are rather limited, but it could be useful

Table 1 — Pascal Reserved Words

Here is a list of Pascal reserved words. Note that this list is the required set of words and that some versions may have more – but not less

AND, ARRAY, BEGIN, CASE, CONST, DIV, DO, DOWNTO, ELSE, END, FILE, FOR, FUNCTION, GOTO, IF, IN, LABEL, MOD, NIL, NOT, OF, OR, PACKED, PROCEDURE, PROGRAM, RECORD, REPEAT, SET, THEN, TO, TYPE, UNTIL, VAR, WHILE, WITH

Table 2 — Standard Functions and Procedures

Every version of Pascal should have the following functions and procedures (with the possible exception of NEW and DISPOSE). All implementations of Pascal on the 64 have more pre-defined procedures which deal with colour and so on. Note that the brackets indicate an argument

GET(), PAGE(), PUT(), READ, READLN, RESET(), REWRITE(), WRITE, WRITELN, ABS(), ARCTAN(), COS(), EXP(), LN(), SIN(), SQR(), SQRT(), EOF(), EOLN() ODD(), CHR(), ORD(), ROUND() TRUNC(), PACK(), UNPACK(), NEW(), DISPOSE(), PRED(), SUCC()

Summary

If you intend to learn computer science then I would strongly recommend that you get a Pascal compiler for your 64. Pascal has a small amount of reserved words, yet many of the up and coming fifth generation languages incorporate Pascal-like structures

As far as recommending one of the three packages I can only suggest this. If you wish to learn Pascal, then Oxford Pascal is by far the best. Even though 'Orpheus' Pascal '64 is very similar, the disk operation within Oxford Pascal is a must. However, Oxford Pascal is a bit pricey, so Orpheus' Pascal 64 would be a very good second

For the more experienced programmer I would recommend First Publishing's Pascal 64. Even though the user interface and daft syntax requirements are off-putting, I say this because the results are quite fast, and it does have a number of advanced features not found in the other packages

David Janda is prepared to discuss this subject further through electronic mail. He can be contacted on the following

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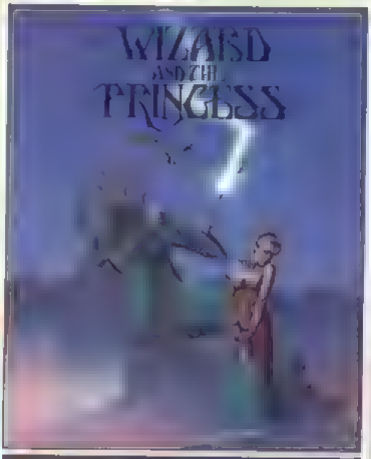

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This month we begin a new series by Steve Carrie. When you've collected all three parts you'll have a full machine code development system.

MACH 1

THE AIM OF THIS SERIES OF programs is to provide the reader with a set of tools to aid in the production of 6502 machine code programs on a C64 suitably equipped with a1541 disk drive

There are three separate programs; a Machine Language Monitor/Editor, a Macro Processor and an Assembler. The Monitor is essentially the control program from which the other two may be called upon to process source code written using the Editor

The Macro Processor is not a full implementation since it does not handle conditional processing. However, it does allow sections of source code to be written as a "macro" with parameters for later inclusion in source code programs.

The Assembler is a two-pass type which produces an executable disk file which may be loaded into memory by using a simple Basic command:

LOAD "filename",8,1

The programs are disk-based since it was necessary to have the random access and reliability that a disk drive affords.

I will first deal with the Monitor/Editor program and then the Macro Processor and Assembler in turn

The Monitor

The four Basic listings, when loaded and RUN in sequence 1-4 will POKE the complete Monitor/Editor program into memory. Each listing contains REM statements to show where the various sections of code begin and end I suggest that you type in and save all four programs before you attempt to generate the code A word of caution here; check your typing carefully as no checksum facility is provided

When all four are ready to be RUN, load and execute them each in turn then give the following Basic direct command

POKE43,0.POKE44,130·POKE 45,128 POKE46,142 SAVE" MONITOR",8,1

Having done this, type

POKE43,1 POKE44,8 NEW

You should now have a copy of the actual program on disk and are ready to test it out.

Monitor Command Summary

Command	Description
+pc,sr,ac,xr,yr,sp	input processor register values. The R command outputs a similar format allowing free use of the C64 screen editor
*addr,byt1,. byt8	input 8 consecutive byte values into memory starting at addr The M command outputs a similar format allowing free use of the C64 screen editor
I	initialises, performs a warm start
M addr1,addr2	display contents of memory between addr1 and addr2
R	displays processor register values
X	exits to Basic command mode
G addr	restores processor register values and begins execution at addr
T addr1,addr2,addr3	copy the contents of memory block addr - addr to a block starting at addr3.
F addr1,addr2,byt	fill the memory block addr1-addr2 with the value byt

Note that in the above commands, the value byte may be given in ASCII format by preceding the character by the apostrophe ( ). For example, F 5000,6000, A will fill the block 5000-6000 hex with the value 41 hex, the ASCII code for "A"

L filename	loads a file into memory at its original address
S filename addr1,addr2	save the memory block addr1-addr2 to a disk file with name filename. Filenames should not contain spaces.

Monitor Command Summary — Multiple Letter Group

RESET	causes the machine to cold start
DIR	displays current disk directory
CAT	displays current disk directory
DERR	displays disk drive status
INIT	initialises drive (disk I command)
COMPACT	validates disk (disk V command)
FORMAT diskname,ID	formats disk (disk N command)
COPY filename=filename	copies a file (disk C command)
RENAME filename=filename	renames a file (disk R command)
SCRATCH filename	deletes a file (disk S command)
HEX	sets default I/O mode to hex
DEC	sets default I/O mode to decima
TTY	defaults output device = PRINTER
VDU	defaults output device = SCREEN
EDITOR	enters Editor mode

Testing the Monitor

Enter the monitor by issuing the direct Basic command.

SYS 33280

You should be given the message

COMMODORE 64 UTILITY SERIES
MONITOR EDITOR O.S. V1.2
(C) 1985 S.D.C.

followed by a " " prompt and a flashing cursor. You are now in Monitor command mode. It is from this that you will command most of the functions of the Monitor/Editor and the other programs.

A summary of commands is given later but for now try the following commands.

Type DERR followed by return. The disk status is given on screen in a form similar to

DISK DR :0, OK,0,0

where DISK DR. indicates that this is a disk status report. Machine reports are prefixed by MACHINE.

Now type DIR The directory of the current disk will be displayed on screen in a format similar to that obtained by using the more usual Basic method LOAD"$",8

Note that some commands, such as COPY and RENAME automatically produce a disk status report to show whether or not the command has been carried out successfully

The formats of the disk commands SCRATCH, COPY etc are the same as are given in the 1541 disk users manua Note that in a l cases, spaces, and not quotes, are required around fi enames For example, the command to save a block of memory to disk is S Thus the format is

S fi-ename addr1,addr2
and not
S "filename" addr,addr2

Now type I. This wil perform a warm start into the monitor. If you type X, the machine will re-enter BAS C To get back into the Monitor, simply type the SYS 33280 command again

One thing to note is that the 6502 BRK vector is now set to jump into the monitor. This means that you may insert BRK instructions into your machine code programs to act as STOPs for debugging purposes To see the effect of this, type the following

POKE2,0 SYS 2

A zero byte is the code for the 6502 BRK instruction. You will be given the entry message as before but this time it wi be preceded by

BREAK

indicating that a BRK instruction was encountered during execution of a machine code program

Any other words typed in are assumed to be "external" commands i e. d sk files which act as commands The programs MACRO and ASSEMBLER are examples of these When you want to ca the Macro Processor for example, assuming you called the program MACRO, you simply type MACRO plus a coupe of fi enames and the Macro processor wil be loaded and run An external command is assumed to begin at address 9000 hex. Therefore, if you want to write a program to act as an external command, it should have a start address of 9000 hex At the end of execution, a JMP $8200 instruction will cause a re-entry to the mon tor

Editor Commands

Command	Description
A	Auto line numbering this is a useful feature since it does away with the need to type in line numbers Two formats are valid 1 A start 10 increment 10 2 A10,20 start 10, increment 20 Format 2 may of course use other numbers.
D	Delete lines there are two methods of line deletion 1 The usual Basic method, type a line number 2 The D command An example wou d be D20-60 which would delete lines 20 through to 60.
R	Renumber lines this simply renumbers the lines of a source code program. The format is the the same as for the A command
L	List program lines – the RUN/STOP key may be used to terminate the listing If a line number is supplied, listing will commence from that line e g. L200 will begin listing at line 200
M	Merge file – the format is Mfilename The file named will be merged onto the end of the file currently in memory
S	Scratch (delete) a file – this is simi ar to the Basic command NEW
I	Initia ise – re-enter ed tor deleting any file currently in memory
*	Exit editor – there are three formats for this command
1 * .	: save file and exit
2 *I	: save file without save
3 *fi-ename	: save file w th a new name and exit

The Editor

The Editor is provided so as to allow preparation of source code in the correct format for the Macro Processor and Assemb er. The basic idea behind the Editor screen format is that source code symbols, operands and mnemonics all have defined areas in a source line These areas are known as FIELDS and both the Macro Processor and Assembler expect to find their source code arranged in these fields

On a normal C64 screen, there are 25 rows of 40 characters. The editor arranges the screen such that there are four fields of 10 characters each numbered one to four starting at the left side Since the normal screen editor w li accept up to 80 characters i.e two lines of text, the last field-field four – may extend for up to a maximum of 50 characters Field one is only used by the Editor to accept and display line numbers. It is not actually stored in the final source program. Field two is the SYMBOL or LABEL field, field three is the INSTRUCTION or MNEMONIC field and field four is the OPERAND fie d

The functions of these fie ds will become clearer as we go on to explain the Macro Processor and Assembler

A typical Editor screen layout is shown below The top line is for guidance only and is not on screen

```
FIELD 1 FIELD 2 FIELD 3 FIELD 4
1000    LABEL 1 JSR     DELAY
1010            LDA     $40
1020            ASL     A
etc...
```

If you re wondering how you are going to keep all the field entries in the right places then read on. When in edit mode, the function key F1 is used as a TAB key When pressed, it will advance the cursor from its present position to the start of the next field For example, suppose the line 1000 in the above example was being typed in The line number would be typed in and the F1 key pressed The cursor would be advanced to the start of field 2 – the L of LABEL1 Pressing F1 again wou d advance the cursor to the start of field 3 – the J of JSR and so on

This feature coupled with an auto line numbering facility makes for easy code entry

Other facilities inc ude l ne renumbering, block line delete, source code file merging and single line delete A program is entered in a similar fashion to a Basic program with the line numbers These numbers are for editing purposes only and do not affect the final object code generated by the assembler. All the normal Commodore screen editing facilities are supported by th s editor

Entering and Leaving the Editor

While in Monitor command mode, enter the command EDITOR The message EDITOR ENTER FILENAME will appear You should enter the name of the file you wish to use If the file exists on the current disk the Editor will read it in and you w ll be able to work on it If however the fi e does not exist on the current disk, the messge

NEW FILE will be printed. In both cases, a flashing cursor (no prompt) will signify Editor command mode.

Before going on to explain the Editor commands, a word or two about leaving it. The name entered as the filename, is stored by the editor. At the end of the editing session the user may simply enter the command * and the file is saved back to disk. An auto disk validate is carried out.

This is done to prevent problems associated with the 1541 " 0 " bug. In some cases it may take a long time to validate a disk especially if it is getting full. Some of you may find this a bit of a nuisance but I personally prefer it to a corrupted disk. If you want to do away with this facility, refer to listing seven which contains details on removing it (see Editor Commands).

When you have the Macro Processor and the Assembler complete, I will give some programming examples to get you get used to the operation of the Editor and its formats. Next month I will give listings of the Macro Processor and a description of Macros and Macro processing.

Monitor Part 1

```
5 REM ** JUMP TABLE **
6 REM ****************
10 DATA 76,114,137,76,152,135,76,1
31,135,76,189,134,76,139,132,76
20 DATA 156,132,76,94,132,76,51,13
2,76,17,132,76,35,132,76,45
30 DATA 132,76,109,135,76,18,135,7
6,16,141
34 REM ***************************
****
35 REM ** COMMAND & MESSAGE TABLES
 **
36 REM ***************************
****
40 DATA 77,0,82,0,71,0,84,0,70,0,7
6,0,83,0,43,0,42,0,73,0,88,0
50 DATA 82,69,83,69,84,0,68,73,82,
0,67,65,84,0,83,67
60 DATA 82,65,84,67,72,0,70,79,82,
77,65,84,0,73,78,73
70 DATA 84,0,67,79,80,89,0,82,69,7
8,65,77,69,0,84,89
80 DATA 80,69,0,67,79,77,80,65,67,
84,0,68,69,82,82,0
90 DATA 72,69,88,0,68,69,67,0,69,6
8,73,84.79,82,0,86
100 DATA 68,85,0,84,84,89,0,255,83
,133,45,133,114,134,50,134
110 DATA 248,133,6,130,3,130,208,1
33,171,133,114,137,158,134,226,252
120 DATA 189,136,189,136,57,135,60
,135,101,135,63,135,66,135,46,136
130 DATA 98,135,9,133,223,135,226,
135,91,139,150,136,156,136,13,10
140 DATA 67,79,77,77,79,68,79,82,6
9,32,54,52,32,85,84,73
150 DATA 76,73,84,89,32,83,69,82,7
3,69,83,46,13,10,77,79
```

Monitor Part 1

```
160 DATA 78,73,84,79,82,32,69,68,7
3,84,79,82,32,79,46,83
170 DATA 46,32,86,49,46,50,13,10,4
0,67,41,32,49,57,56,53
180 DATA 32,83,46,68,46,67,46,13,1
0,13,10,0,13,13,10,42
190 DATA 42,32,66,82,69,65,75,32,6
9,78,84,82,89,32,42,42
200 DATA 13,10,0,42,79,75,46,13,10
,0,13,10,78,69,87,32
210 DATA 70,73,76,69,13,10,13,10,0
,13,10,69,68,73,84,79
220 DATA 82,13,10,0,13,10,42,42,69
,82,82,79,82,42,42,13
230 DATA 10,0,13,10,77,65,67,72,73
,78,69,32,58,32,0,68
240 DATA 73,83,75,32,68,82,32,58,3
2,0,13,10,32,32,32,32
250 DATA 80,67,32,32,83,82,32,65,6
7,32,88,82,32,89,82,32
260 DATA 83,80,13,10,62,43,32,0,13
,10,69,78,84,69,82
264 REM ***************************
****
265 REM ** INPUT EVALUATION SUBRT.
 **
266 REM ***************************
****
270 DATA 32,70,73,76,69,78,65,77,6
9,32,0,238,64,48,58,255,32
280 DATA 138,173,76,247,183,201,48
,144,18,201,71,176,14,201,58,176
290 DATA 3,41,15,96,201,65,144,3,2
33,55,96,76,72,178,32,121
300 DATA 0,32,181,131,72,32,115,0,
32,24,130,144,20,104,10,10
310 DATA 10,10,133,2,32,121,0,32,1
81,131,5,2,133,2,76,115
320 DATA 0,104,133,2,96,32,206,131
,165,2,133,20,32,121,0,32
330 DATA 24,130,176,1,96,32,206,13
1,165,20,133,21,165,2,133,20
340 DATA 96,32,27,130,144,1,96,201
,65,144,6,201,71,176,2,56
350 DATA 96,24,96,201,48,144,250,2
01,58,176,246,56,96,32,18,177
360 DATA 144,241,96,169,0,133,20,1
33,21,32,121,0,201,39,208,6
370 DATA 32,115,0,133,20,96,173,17
4,2,240,3,76,245,131,32,121
380 DATA 0,76,175,131
1000 FORS=33280 TO 33875
1010 READA:POKES,A
1020 NEXT
1030 PRINT"FINISHED"
```

Monitor Part 2

```
5 REM ** OUTPUT SUBROUTINES **
6 REM ************************
10 DATA 169,32,76,210,255,169,44,7
6,210,255,169,13,32,210,255,169
20 DATA 10,76,210,255,169,147,76,2
10,255,72,74,74,74,74,32,129
30 DATA 132,32,210,255,104,41,15,3
2,129,132,76,210,255,201,10,144
40 DATA 3,105,54,96,9,48,96,173,17
4,2,240,8,152,32,109,132
50 DATA 138,76,109,132,152,76,205,
189,72,173,174,2,240,4,104,76
60 DATA 109,132,104,134,253,132,25
4,170,169,0,32,205,189,164,254,166
70 DATA 253,96,169,6,160,5,162,15,
140,32,208,141,134,2,142,33,208,96
74 REM ****************************
****
75 REM ** ERROR HANDLING **
76 REM ***************************
****
80 DATA 138,16,3,108,2,3,72,32,190
,138,169,98,160,131
90 DATA 32,30,171,104,10,170,169,1
28,133,157,189,38,163,133,34,189
100 DATA 39,163,133,35,32,204,255,
169,0,133 19,32,220,170,160,0
110 DATA 177,34,72,41,127,32,71,17
1,200,104 16,244,32,122,166,32
120 DATA 18,130,108,2,3,32,18,130,
169,111 160,131 32,30,171,162
130 DATA 15,32,198,255,32,228,255,
32,210,255,201,13 208,246,162,0
140 DATA 32,198,255,32,18,130,108,
2,3
144 REM ***************************
***
145 REM ** MONITOR O.S. SUBRT.
146 REM ***************************
***
149 DATA 169,122,160,131,32,30,171
150 DATA 172,168,2,174,167,2,32,12
,130,162,0,32,89,132,189,169
160 DATA 2,32,15,130,232,224,5,208
,242,32,18,130,108,2,3,32
170 DATA 21,130,165,20,133,251,165
,21,133 252,32,253,174,32,21,130
180 DATA 32,18,130,169,62,32,210,2
55,169,42 32,210,255,32,84,132
190 DATA 164,252,166,251,32,12,130
,160,0,32,89,132,177,251,32,15
200 DATA 130,200,192,8,144,243,32,
225 255,240,22,152,24,101,251,133
210 DATA 251,165,252,105,0,133,252
,197,21,144,197,165,251,197 20,144
220 DATA 191,32,18,130,108,2,3,32,
21,130,165,20,133,251,165,21
230 DATA 133,252,160,0,132,90,32,2
53,174,32,21,130,164,90,165,20
240 DATA 145,251,200,132,90,192,8,
144,235,108,2,3,32,21,130,165
250 DATA 20,166,21,141,167,2,142,1
68,2,162,0,134,253,32,253,174
260 DATA 32,21,130,165,20,166,253,
157,169,2,232,134,253,224,5,144
270 DATA 234,108,2,3,32,21,130,165
,20,166,21,133,251,134,252,32
280 DATA 253,174,32,21,130,165,20,
166,21,133,253,134,254,32,253,174
290 DATA 32,21,130,160,0,165,20,14
5,251,230,251,208,2,230,252 165
300 DATA 251,197,253,208,240,165,2
52,197,254,208,234,108,2,3,32,21
310 DATA 130,165,20,166,21,133,251
,134,252,32,253,174,32,21,130,165
320 DATA 20,166,21,133,253,134,254
,32,253,174,32,21,130,160,0,177
330 DATA 251,145,20,230,251,208,2,
230,252,230,20,208,2,230,21,165
340 DATA 251,197,253,208,234,165,2
52,197,254,208,228,108,2,3,32,121
350 DATA 0,240,13,32,21,130,165,20
,166,21,141,167,2,142,168,2
360 DATA 174,173,2,154,173,168,2,7
2,173,167,2,72,173,169,2,72
370 DATA 173,170,2,174,171,2,172,1
72,2,64,169,139,162,227,141,0
380 DATA 3,142,1,3,169,131,162,164
,141,2,3 142,3,3,174,173
390 DATA 2,154,169,128,133,157,76,
123,227
400 REM ***************************
***
1000 FORS=33876 TO 34492
1010 READA:POKES,A
1020 NEXT
1030 PRINT"FINISHED"
```

```
5 REM ***************************
***
6 REM I/O SUBROUTINES
7 REM ***************************
**
10 DATA 32,121,0,162,0,164,122,132
,93,185,0,2,240,15,201,32
20 DATA 240,11,200,232,224,50,144,
241,162,23,108,0,3,132,122,224
30 DATA 0,208,5,162,8,108,0,3,164,
93,96,32,9,130,134,2
40 DATA 152,170,169,58,202,157,0,2
,202,165,94,157,0,2,134,94
50 DATA 166,2,232,232,134,2,165,94
,133,90,169,2,133,91,164,2
60 DATA 169,0,145,90,96,169,15,162
,8,160,15,32,186,255,169,0
70 DATA 32,189,255,76,192,255,169,
15,76,195,255,162,15,32,201,255
80 DATA 165,94,160,2,32,30,171,162
,0,76,201,255,169,83,44,169
90 DATA 78,44,169,67,44,169,82,133
,94,32,232,134,32,40,135,76
100 DATA 9,133,141,70,2,169,0,141,
71,2,169,1,133,2,169,70
110 DATA 133,94,76,40,135,169,86,4
4,169,73,32,79,135,108,2,3
120 DATA 32,9,130,138,72,152,170,1
04,160,2,76,189,255,169,1,162
130 DATA 8,160,1,76,186,255,32,33,
130,32,122,135,169,0,32,213
140 DATA 255,144,5,162,4,108,0,3,1
08,2,3,32,33,130,32,122
150 DATA 135,169,32,32,255,174,32,
21,130,165,20,166,21,72,138,72
160 DATA 32,253,174,32,21,130,166,
20,164,21,104,133,21,104,133,20
170 DATA 165,1,41,254,133,1,169,20
,32,216,255,8,165,1,9,1
180 DATA 133,1,40,144,5,162,24,108
,0,3,32,183,255,208,246,108
190 DATA 2,3,169,255,44,169,0,141,
174,2,169,51,160,131,32,30
200 DATA 171,108,2,3,32,207,255,72
,32,183,255,41,64,208,2,104
210 DATA 96,104,162,0,32,198,255,1
69,2,32,195,255,108,2,3,169
220 DATA 2,162,8,160,2,32,186,255,
32,33,130,24,32,192,255,176
230 DATA 11,32,183,255,208,6,96,16
2,2,76,198,255,162,4,108,0
240 DATA 3,32,12,136,32,204,255,32
,131,136,32,241,135,32,241,135
250 DATA 32,241,135,32,241,135,32,
241,135,32,241,135,160,0,32,241
260 DATA 135,48,251,153,0,2,200,20
1,0,208,243,32,204,255,32,120
270 DATA 136,169,0,160,2,32,30,171
,32,18,130,32,204,255,32,131
280 DATA 136,32,225,255,240,140,16
0,0,76,61,136,173,175,2,208,1
290 DATA 96,162,200,76,201,255,162
,2,76,198,255,162,0,142,175,2
300 DATA 32,201,255,169,200,32,195
,255,96,32,136,136,108,2,3
310 DATA 169,200,141,175,2,162
311 REM ***************************
****
312 REM THIS IS THE DEVICE NUMBER
FOR
313 REM THE PRINTER
314 REM ***
315 DATA 4
316 REM ***
317 REM CHANGE TO WHATEVER YOU NEE
D
318 REM ***************************
****
319 DATA 160,1,32,186,255,169,0,32
,189,255
320 DATA 169,4,141,147,2,32,192,25
5,162,200,32,201,255,108,2,3
330 DATA 32,136,136,169,36,133,251
,169,48,133,252,169,2,162,251,160
340 DATA 0,32,189,255,169,1,162,8,
160,0,32,186,255,32,192,255
350 DATA 144,10,72,165,184,32,195,
255,104,76,9,133,160,3,132,183
360 DATA 165,184,32,198,255,32,207
,255,133,87,32,183,255,208,105,32
370 DATA 207,255,133,88,32,183,255
,208,95,164,183,136,208,224,132,18
8
380 DATA 32,207,255,72,32,183,255,
170,104,224,0,208,75,164,183,192
390 DATA 80,176,69,153,0,2,170,240
,4,230,183,208,227,162,0,32
400 DATA 198,255,166,87,165,88,32,
205,189,169,32,32,210,255,160,0
410 DATA 185,0,2,240,6,32,210,255,
200,208,245,32,18,130,162,0
420 DATA 32,198,255,32,225,255,240
,16,32,228,255,201,32,208,5,32
430 DATA 228,255,240,251,160,2,208
,164,162,0,32,198,255,165,184,32
440 DATA 195,255,76,9,133
```

Monitor Part 3

```
444 REM ************************
***
445 REM ENTRY POINT/MAIN LOOP
446 REM ************************
449 DATA 169,150,162,137,141,22,3,
142,23,3,169
450 DATA 198,162,132,141,0,3,142,1
,3,169,219,162,137,141,2,3
460 DATA 142,3,3,234,234,234,76,18
8,137,104,141,172,2,104,141,171
470 DATA 2,104,141,170,2,104,141,1
69,2,104,105,255,141,167,2,104
480 DATA 105,255,141,168,2,169,28,
160,131,32,30,171,76,114,137,32
490 DATA 182,132,169,1,141,174,2,1
69,130,162,0,134,51,134,55,133
500 DATA 52,133,56,169,206,160,130
,32,30,171,186,142,173,2,32,182
510 DATA 132,169,0,133,157,32,35,1
35,169,62,32,210,255,174,173,2
520 DATA 154,32,96,165,134,122,132
,123,32,115,0,201,62,240,249,201
530 DATA 0,240,219,166,122,134,93.
160,0,132,2,185,42,130,201,255
540 DATA 240,65,201,0,240,25,221,0
,2,208,4,232,200,208,236,185
550 DATA 42,130,240,3,200,208,248,
200,166,122,230,2,76,8,138,189
560 DATA 0,2,32,19,177,144,6,185,4
2,130,76,19,138,165,2,10
570 DATA 134,122,170,189,152,130,1
33,20,189,153,130,133,21,32,18,135
580 DATA 108,20,0,165,93,133,122,1
69,2,133,123,32,18,135,32,33
590 DATA 130,32,122,135,24,169,0,3
2,213,255,176,6,32,35,135,76
600 DATA 0,144,162,4,108,0,3
1000 FOR S=34493 TO 35443
1010 READ A:POKES,A
1020 NEXT
1030 PRINT"FINISHED"
```

Monitor Part 4

```
5 REM ************************
6 REM EDITOR SUBROUTINES 1
7 REM ************************
***
10 DATA 162,10,160,4,189,0,2,232,2
00,153,251,1,185,251,1,208
20 DATA 243,153,253,1,198,123,169,
255,133,122,96,120,169,116 162,138
30 DATA 141,4,3,142,5,3,169,240,16
2,138,141,2,3,142,3,3
40 DATA 169,255,133,129,169,104,16
2,140,141,20,3,142,21,3,169,218
50 DATA 162,141,141,0,3,142,1,3,88
,96,120,169,124,162,165,141
60 DATA 4,3,142,5,3,169,32,133,129
,169,219,162,137,141,2,3
70 DATA 142,3,3,169,49,162,234,141
,20,3,142,21,3,169,198,162
80 DATA 132,141,0,3,142,1,3,88,96
84 REM ************************
****
85 REM ** EDITOR MAIN LOOP
86 REM ************************
****
89 DATA 108,2,3,32,35,135,32
90 DATA 18,135,32,96,165,134,122,1
32,123,32,115,0,170,240,237,162
100 DATA 255,134,58,144,68,201,42,
208,3,76,252,139,201,76,208,3
110 DATA 76,88,141,201,82,208,3,76
,241,140,201,73,208,6,32,190
120 DATA 138,76,91,139,201,68,208,
3,76,166,140,201,83,208,6,32
130 DATA 80,140,108,2,3,201,77,208
,3,76,178,141,201,65,208,6
140 DATA 32,228,141,108,2,3,108,0,
3,32,107,169,32,121,0,208
150 DATA 3,76,230,140,76,159,164,3
2,136,136,169,73,160,131,32,30
160 DATA 171,32,80,140,169,0,141,1
74,2,169,152,160,131,32,30,171
170 DATA 32,96,165,134,122,132,123
,32,115,0,170,208,3,76,109,139
180 DATA 160,0,185,170,131,153,176
,2,200,201,255,208,245,32,33,130
190 DATA 165,183,201,20,144,5,162,
23,108,0,3,160,0,162,3,177
200 DATA 187,153,180,2,200,232,196
,183,144,245,142,176,2,169,180,160
210 DATA 2,133,187,132,188,202,202
,202,134,183,32,122,135,32,143,138
220 DATA 169,0,32,213,255,144,13,3
2,18,130,169,58,160,131,32,30
```

Monitor Part 4

```
230 DATA 171,76,101,135,32,18,130,
32,228,139,32,99,166,108,2,3
240 DATA 169,255,160,1,145,43,32,5
1,165,165,34,24,216,105,2,133
250 DATA 45,165,35,105,0,133,46,96
,160,1,177,43,208,3,76,66
260 DATA 140,32,228,139,32,115,0,2
40,13,201,33,240,49,32,33,130
270 DATA 32,122,135,76,39,140,32,1
22,135,173,176,2,162,177,160,2
280 DATA 32,189,255,166,45,164,46,
169,43,32,216,255,144,3,76,210
290 DATA 135,32,183,255,240,3,76,2
10,135
291 REM ************************
***
292 REM TO REMOVE AUTO-VALIDATE, R
EPLACE LINE 295 WITH THIS
293 REM 295 DATA 234,234,234,234,2
34
294 REM ************************
***
295 DATA 169,86,32,79,135
296 REM ************************
****
300 DATA 32,190,138,169,1,141,174,
2,32,18,130,76,114,137
304 REM ************************
****
305 REM ** EDITOR SUBROUTINES 2
306 REM ************************
****
310 DATA 169,0,168,145,43,200,145,
43,165,43,24,105,2,133,45,165,44,1
05,0,133
320 DATA 46,76,99,166,165,197,201,
64,208,3,76,49,234,201,4,208
330 DATA 249,165,198,208,245,56,32
,240,255,152,56,233,10,176,252,73
340 DATA 255,105,1,170,232,160,0,2
02,240,9,169,29,153,119,2,200
350 DATA 76,139,140,132,198,162,96
,160,255,136,208,253,202,208,248,7
6
360 DATA 49,234,32,115,0,32,21,130
,32,19,166,144,61,165,95,72
370 DATA 165,96,72,169,45,32,255,1
74,32,21,130,32,19,166,144,42
380 DATA 160,1,177,95,170,136,177,
95,168,104,133,96,104,133,95,152
390 DATA 160,0,145,95,200,138,145,
95,200,177,95,133,20,200,177,95
400 DATA 133,21,169,0,141,0,2,76,1
64,164,76,227,168,32,247,140
410 DATA 108,2,3,32,115,0,240,20,3
2,21,130,165,20,133,251,165
420 DATA 21,133,252,32,253,174,32,
21,130,76,28,141,169,10,162,0
430 DATA 133,251,133,20,134,252,13
4,21,165,43,166,44,133,253,134,254
440 DATA 160,1,177,253,208,4,32,18
,130,96,160,3,165,252,145,253
450 DATA 136,165,251,145,253,136,1
77,253,170,136,177,253,133,253,134
,254
460 DATA 165,251,24,101,20,133,251
,165,252,101,21,133,252,80,209,162
470 DATA 15,108,0,3,32,115,0,240,9
,32,21,130,32,19,166,76
480 DATA 110,141,165,43,166,44,133
,95,134,96,160,1,177,95,208,6
490 DATA 32,18,130,108,2,3,160,2,1
77,95,170,200,177,95,32,205
500 DATA 189,56,32,240,255,160,10,
24,32,240,255,160,4,177,95,240
510 DATA 6,32,210,255,200,208,246,
32,18,130,160,1,177,95,170,136
520 DATA 177,95,133,95,134,96,32,2
25,255,240,197,76,110,141,32,115
530 DATA 0,32,33,130,169,1,162,8,1
60,0,32,186,255,165,45,56
540 DATA 233,2,170,165,46,233,0,16
8,169,0,24,32,213,255,176,3
550 DATA 76,216,139,108,0,3,169,84
,160,131,32,30,171,108,2,3
560 DATA 32,115,0,208,13,169,10,16
2,0,133,251,134,252,133,253,76
570 DATA 11,142,32,21,130,32,253,1
74,165,20,133,251,165,21,133,252
580 DATA 32,21,130,165,20,133,253,
169,21,162,142,141,2,3,142,3
590 DATA 3,173,0,2,240,46,166,251,
165,252,32,85,142,169,11,133
600 DATA 198,160,0,169,29,153,119,
2,200,192,11,144,246,189,0,2
610 DATA 157,119,2,202,16,247,24,1
65,251,101,253,133,251,144,2,230
620 DATA 252,76,240,138,169,240,16
2,138,141,2,3,142,3,3,108,2
630 DATA 3,134,99,133,98,162,144,5
6,32,73,188,32,223,189,32,135
640 DATA 180,32,166,182,162,0,189,
0,1,157,0,2,240,3,232,208
650 DATA 245,96
1000 FOR S=35444TO36469
1010 READA:POKES,A
1020 NEXT
1030 PRINT"FINISHED"
```

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PROGRAMMING THE C16

This month Joe Nicholson continues our C-16 series with an explanation of programmable characters.

Programmable characters

IT IS POSSIBLE TO USE CUSTOM DESIGNED character sets on the C-16, even though Basic 3.5 does not have supporting commands

To understand how this is done, one must first examine how the normal character set is stored. Data for the character shapes is stored in the ROM from address $D000 to address $D7FF (53258 to 55295) Locations $D000 to $D3FF (53248 to 54271) hold the data for character set 1 (upper case letters and graphics). Locations $D400 to $d7FF (54272 to 55295) hold the data for character set 2 upper and lower case letters). Each of the two character sets takes up 1K of memory Characters with screen codes between 128 and 255 are reversed images of codes 0 to 127 and are therefore not stored in memory

The characters are stored in the order shown in the screen display codes in Appendix E of the *C-16 User Manual* For set 1, the first character is therefore '@' This is stored in eight bytes, one byte per pixel line (eight dots) of the screen display. Each byte of the character '@' contains the eight bits needed for each row of the character, stored in binary form (one for on, nought for off) The left-most bit of the row is the '128' bit, the second to the left is lthe '64' bit and so on to the '1' bit on the far right

The '@' sign is therefore stored as shown in Figure 1

For a character set to be created in RAM, space must first be made available in which to put the character set Assuming the high-resolution screen will not be used in conjunction with programmable characters, the top 1K of RAM (15360-16383) is the most convenient This is done by moving the 'Highest address used by Basic' pointer (55-56) and the 'Bottom of string storage' pointer (51-52) down 1K from the top of RAM (see last month's article The Memory map and where to store machine code) Type

POKE 56,59 POKE 52,59 CLR

As 'CLR' is used this should be done at the beginning of the program

Assuming you don't want to redefine all 128 characters of the new character set, you need first to move one of the ROM character sets down into the 1K block. This can be done easily by entering the MONITOR and typing

T D000 D3FF 3C00 — for set 1, or
T D400 D7FF 3C00 — for set 2.

Then enter 'X' to leave the Monitor

To move the character set down inside a Basic program is more difficult. A FOR-NEXT loop takes over 15 seconds, so I've written a short machine code routine which does the task almost instantly The program is completely relocatable, i.e. it will work wherever it is stored in memory The Start, End and Length values may be altered as desired for different applications. Figure 2 shows an assembler listing of the routine using the C-16 Assembler published in the June edition of Your Commodore It is positioned in a free space below Basic at $600 hex, 1536 decimal (see last month' Where to store machine code). To execute the routine from Basic, type SYS 1536

To make your character set the current one, you must first disable the Shift+Commodore Key with PRINT CHR$(8), and then set the 'Character data base address' pointer (at 65299) as desired Bits two to seven of this pointer are the upper six bits of the high byte of the character set address. This enables the character set to start at any multiple of 1K. We are using the fifteenth K (15360 to 16383), so the number entered is 60 (15*4) decimal

To specify that the character set will be

```
START: 10000  ;SHIFT MEMORY
 10010  ORG $600
 10015  ;
 10020  ;START READING FROM
 10030  LDA #0
 10040  STA $D0
 10050  LDA #$D0
 10060  STA $D1
 10070  ;
 10080  ;START WRITING TO
 10090  LDA #0
 10100  STA $D2
 10110  LDA #3C
 10120  STA $D3
 10130  ;
 10140  ;NUMBER OF BLOCKS TO
 10150  ;BE MOVED (4 FOR 1K)
 10160  LDX #4
 10170  ;
 10180  ;PERFORM MOVE
 10190  ;L1 LDY #0
 10200  ;L2 LDA ($D0),Y
 10210  STA ($D2),Y
 10220  INY
 10230  BNE R:L2
 10240  INC $D1
 10250  INC $D3
 10260  DEX
 10270  BNE R:L1
 10280  RTS
>> OK.
```

Figure 1.

Address hex	Hex	Binary	Image
$D000	$3C	00111100	****
$D001	$66	01100110	** **
$D002	$6E	01101110	** ***
$D003	$6E	01101110	** ***
$D004	$60	01100000	**
$D005	$62	01100010	** *
$D006	$3C	00111100	****
$D007	$00	00000000	

Figure 2. Shift memory routine

accessed from RAM as opposed to ROM, bit two of address 63298 must be set. As it is important that the other bits at that address should remain unchanged, a line like this should be used

POKE 65298,PEEK (65298) AND 251

to specify 'character set in RAM'. To get back to the normal ROM character set, the following POKEs should be entered

POKE 65299, 208
POKE 65298,PEEK (65298) OR 4

Whenever an Error is encountered the ROM/RAM select bit is reset back to ROM, creating havoc on the screen if the 'Character data base address' pointer is not pointing to the ROM character set. This means that editing should always be done in normal (ROM) character mode.

Also, it is a good idea to put the 'get back to the normal character set' commands as the destination of a TRAP command to stop this happening (see page 141 of the *User Manual*). Remember, however, that the TRAP command must come after the CLR command used when lowering the top of RAM.

```
10 REM PROGRAMMABLE GRAPHICS DEMO
100 POKE56,59:POKE52,59:CLR
110 FORA=1536TO1570:READB:POKEA,B:NEXT:S
YS1536
150 DATA169,0,133,208,169,208,133,209,16
9,0,133,210
160 DATA169,60,133,211,162,4,160,0,177,2
08,145,210
170 DATA200,208,249,230,209,230,211,202,
208,240,96
200 RESTORE10000:FORA=0TO79:READB:POKE15
360+A,B:NEXT
210 PRINTCHR$(8):POKE65299,60:POKE65298,
PEEK(65298)AND251
220 TRAP250:GOTO1000
250 PRINTERR$(ER),EL
260 POKE65299,208:POKE65298,PEEK(65298)O
R4:END
1000 COLOR0,1:COLOR4,1:COLOR1,8,6:SCNCLR
1010 PRINT FFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFF ;
1020 FORA=1TO22:PRINT"F"TAB(39)"F";:NEXT
1030 PRINT FFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFF"
1040 COLOR1,2,6:CHAR,18,21,"GHI"
1050 COLOR1,2,4:CHAR,0,24,  0015423
                            0000000"
1100 FORB=3TO12:FORA=1TO6:COLOR1,A+1,4
1110 CHAR,B,(A*3)-1,  @AB  @AB  @AB  @AB
  @AB"
1120 CHAR,B,(A*3)," CDE  CDE  CDE  CDE
CDE"
1130 FORC-1TO100:NEXT:NEXT:NEXT
1200 FORB 12TO3STEP-1:FORA=1TO6:COLOR1,A
+1,4
1210 CHAR,B,(A*3)-1,"@AB  @AB  @AB  @AB
 @AB
1220 CHAR,B,(A*3),"CDE  CDE  CDE  CDE  C
DE
1230 FORC=1TO100:NEXT:NEXT:NEXT
1240 GOTO1100
10000 DATA32,96,192,159,191,255,255,253
10010 DATA0,0,0,195,231,231,255,61
10020 DATA4,6,3,249,253,255,255,63
10030 DATA253,252,255,255,121,63,1,1
10040 DATA189,24,255,60,231,255,195,195
10050 DATA191,63,255,255,158,252,128,128
10060 DATA255,128,191,161,165,189,129,25
5
10070 DATA0,0,0,3,15,31,63,255
10080 DATA24,24,126,255,255,255,255,255
10090 DATA0,0,0,192,240,248,252,255
```

Figure 3. Programmable graphics demo

Entering programmable characters

The address of the character in RAM can be found as follows

Address = Base address + (screen code * 8)

The eight bytes for each character can be read into memory by a simple FOR-NEXT loop, with the numbers stored in DATA statements. Figure 3 is a demonstration program to illustrate the points covered in this article. The program functions as follows

LINE 100 shifts the top of memory down 1K for the new character set
LINE 110 POKEs into memory the machine code routine SHIFT MEM held in the DATA statements in line 150-170. It then calls this routine. The routine shifts the ROM upper case character set down into the new RAM area
LINE 200 READs in the Programmable character data stored in lines 10000-10090 into the start of the new character set (first character to be defined is '@', then 'A' then 'BN' etc.)
LINE 210 – 'PRINT CHR$(8)' – disables the ability to change character sets with the Shift+Commodore Key. As only one character set has been redefined, this disables the ability to change to a garbage character set
LINE 220 turns on TRAP mode to Line 250 and jumps to the Demonstration (Line 1000)
LINE 250-260 The TRAP routine
LINE 250 prints the error and the line number on which the error occurred
LINE 260 first changes the BASE address to point to the ROM character set, then selects 'character set to be taken from ROM', then ENDS.
LINE 1000 defines the colours and clears the screen
LINES 1010-1030 print the border
LINE 1040 prints your base
LINE 1050 prints the scores
LINES 1100-1130 move aliens right
LINES 1200-1230 move aliens right
LINE 1240 performs this spectacular feat of imagination all over again
LINES 10000-10090 the programmable characters
LINES 10000-10050 the six programmable characters needed for the alien
LINE 10060 the border character
LINE 10070-10090 the base

LISTINGS

Listings will be much easier to enter with our new system.

COMMODORE LISTINGS ARE RATHER well known for the horrible little black blobs that always abound. Unfortunately the graphics characters which are used to represent graphic and control characters do not reproduce very well and they are also difficult to find on the Commodore keyboard.

For this reason Your Commodore started to precede any control characters with a REM statement on the previous line that explained exactly what the black blobs were meant to be. Unfortunately the graphics characters were not documented and these still cause some confusion. For this reason we are starting to use a new method for marking the control and graphic characters in our listings.

In future all control and graphics commands will be replaced by mnemonic within square brackets. This mnemonic is not typed out as printed in the magazine but rather the corresponding key or keys on the keyboard are pressed. For example [RIGHT] means press the cursor right key. You do not type in [RIGHT]. All of the keywords, what keys to press and how they are shown on the screen are shown below.

Any character that is accessed by pressing shift and letter will be printed as [s LETTER]

[s A] shift and A
[s C] shift & C

Any character that is accessed by pressing the Commodore key and a letter will be printed as [c LETTER]

[c A] Commodore & A
[c C] Commodore & C
[c 1] Commodore & 1

Any control key will be printed out as a number. For example [001]. Control codes are accessed by pressing the CTRL and a letter at the same time. [001] is CTRL & A, 002 is CTRL & B etc. See the manual for more information about control codes.

[001] CTRL & A
[026] CTRL & Z

Mnemonic	Symbol	what to press
[RIGHT]		cr right
[LEFT]		shift cr right
[UP]		shift & up down
[DOWN]		up down
[F1]		f1
[F2]		shift & f1
[F3]		f3
[F4]		shift & f3

Mnemonic	Symbol	what to press
[F5]		f5
[F6]		shift & f5
[F7]		f7
[F8]		shift & f7
[CLEAR]		shift & CLR HOME
[HOME]		CLR HOME
[RVSON]		CTRL & 9
[RVSOFF]		CTRL & 0

Mnemonic	Symbol	what to press
[BLACK]		CTRL & 1
[WHITE]		CTRL & 2
[RED]		CTRL & 3
[CYAN]		CTRL & 4
[PURPLE]		CTRL & 5
[GREEN]		CTRL & 6
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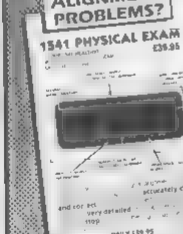

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FULL SPEED AHEAD

Give your data recorder the speed of a disk drive with this program from Nick Hampshire.

THE MOST TEDIOUS AND frustrating operation on the C64 is using the cassette deck to LOAD or SAVE a program. The operating system tape routines function OK but are so cumbersome and slow that the thought of buying a disk drive soon becomes a matter of very high priority in every user's mind. However, while waiting for your disk drive, all is not lost. With an ingenious piece of software, it is possible to speed up the tape routines to give a loading speed equal to that of a disk drive.

Virtually all C64 software currently being marketed uses some form of fast loader. These fast loaders are given names like Turbo (this was the first fast loader available), Pavload, Flash Load, etc. The origin of these fast loader routines is rather obscure since many of the software houses use the same loader routines. In this section we give the source code for two fast loaders and their associated SAVE routines. These have been used on several software products of Zifra Software Ltd under the name of *ZITload* and *ZIFTAload*.

A fast loader is a routine which replaces the existing LOAD and allows a program or data to be loaded from tape at about 10 times normal speed thus making a tape as fast as a disk drive. A fast loader simply changes the format of the pulse sequence stored onto the tape in order to allow a far greater density of information storage per inch.

In order to create a fast loader two programs are needed. Firstly, a fast loader program, which is a fairly short machine code routine loaded at the beginning of a LOAD operation and auto run to LOAD the rest of the program and/or data stored in fast loader format. The second program is a routine to SAVE a program in fast loader format, the fast SAVE.

The first major design problem to be overcome is the storage of each bit on the tape. Each bit is stored as a pulse which goes through a high-low transition (see Figure 1). The length of the total pulse decides whether the bit is a one – A long pulse – or a zero – a short pulse. The bit is flagged in the interrupt register on the falling edge of the pulse.

The loader is a machine code program which runs with the interrupts disabled. It sets a timer between the two lengths, and when the timer runs out the interrupt register is checked to see if the pulse came in or not. If the falling edge of the pulse generates an interrupt before the timer runs out then the pulse was a zero, otherwise it was a one. The bits are then rotated into a byte storage until eight bits have been read, thereby loading a full byte.

Before any bytes can be read and stored, the loader must be in sync with the bits on the tape. A string of zero bits with a single one bit at every byte interval achieves this. The routine then tries to align itself by recognising the value of the byte.

An example of a header byte for aligning would be the value 64, hex $40 or, in binary, 01000000. A series of these bytes is written as the header. Only when this byte has been read in and recognised can the actual program be read without risk of alignment errors.

The program is stored in different ways depending on how much is desired. The simplest way of formatting the file is to first SAVE the two byte load address followed by the two byte end address and then the actual file. The final byte following the end of the file is a checksum calculated by the save routine and also during loading. If the two values are the same, the LOAD was successful. The routine for this form of fast loader is given in Program one.

Another type of LOAD, which uses the same saver but is slower, is the interrupt loader. This method has the advantage of LOADing with the screen on and a foreground program running whilst the main program is loaded. Loaders of this type are Novaload and Micro Load. The difference is that an interrupt is created when a pulse is read by the tape recorder, and the timer is checked to find out whether the pulse was a zero or a one. The whole LOAD is done in the background allowing a foreground program to play music, run a clock, etc. The foreground program must check at regular intervals to see if the loader has flagged for the end of load. The background LOAD in Program two has only a foreground program which is waiting for the end of LOAD flag to be set.

Fast Tape Routines — Making Them Work

Putting the theory into practice to create the fast loader routines is not difficult. The actual timing for the SAVE routine was not calculated from any theoretical formula but just by trial and error. The only guidelines were that the short pulse should be slightly shorter than half the long pulse, as the waveform of the pulse is evened out by the cassette hardware. The timing value used by the loader is just shorter than the time required before the long pulse reaches its falling edge.

There are two program listings for the C64 in this article, one for each of the two types of LOAD. Each program will SAVE a Basic program in its fast format and automatically put the fast loader routine into the filename where it is stored. When loaded, it will automatically start on the warm start vector. The routines are initialised by SYS(49152). A Basic program can be fast saved by using the SAVE command as normal but with a device number of seven, thus

```
SAVE "PROGRAM",7
```

In addition the first fast LOAD also makes use of the secondary address to auto run the program, thus

```
SAVE "PROGRAM",7,1
```

will cause the program to auto run when loaded back. With both routines, when a program has been saved using one of these fast loader SAVE routines it is unnecessary to LOAD anything before the program. It will LOAD directly from the LOAD command.

An example of how fast these routines can be is shown by the following timing table. This was based on the time taken to LOAD a 26.3K byte Basic program.

Method 1
: 1 minute

Disk
: 1 minute 10 seconds

Method 2
: 1 minute 25 seconds

Normal tape
: 8 minutes 40 seconds

It should also be noted that the SAVE routines for the fast tape operation are considerably shorter than the normal tape routines. One wonders why Commodore has not included these types of fast tape routines in the new machines.

By loading these into your C64 you will be able to take some of the tedium and frustration out of using a tape system. In addition it will also make your programs look far more professional.

This article is extracted from one of the *64 Revealed* series of books by Nick Hampshire and published by Collins.

```
0300          FAST TAPE SAVE FOR THE 64
0303          ****************************
0305
0308          ;THIS ROUTINE WILL SAVE A PROGRAM
030B          ;TE TAPE SO THAT WHEN  LOADED BACK
030E          ; I WILL LOAD W TH THE SCREEN ON.
0311
0300          *=$C000
C000 A98B                 LDA #$CBVEC      ;CHANGE SAVE VECTOR
C002 8D3003               STA $0330        ; TO GO TO HERE
C005 A9C0                 LDA #$C0SAVEC    ; SAVE ROUTINE
C007 8D2003               STA $0320
C00A 60                   RTS
C00B      ;
C00B 48     SAVVEC        PHA              SAVE OFF A
C00C A08A                 LDA #$8A         ;GET DEVICE 8
C00E C007                 CMP #$07         ;NUMBER 7?
C010 F004                 BEQ TSAVE        ;YES
C012 68                   PLA
C013 4CE8F5               JMP $F5E8        ;DO NORMAL SAVE
C016      ;
C016 A9AC   TSAVE         LDY #$AC
C018 A928                 LDA #$28
C01A 9039C1 LOOP1         STA FILNAME+1,Y  ;BLANK FILENAME
C01D 88                   DEY
C01E D0FA                 BNE LOOP1
C020 A487                 LDY $87          GET FILENAME LENGTH
C022 C00                  CPY #$0F         GREATER THAN 14?
C024 9002                 BCC LOOP2        ;NO
C026 A00E                 LDY #$0E         ;ONLY 1ST 14 CHARS
C028 88     LOOP2         DEY
C029 B900                 LDA ($BB),Y      GET FILENAME
C02B 9900C1               STA FILNAME,Y    ;STORE IT
C02E 9024C1               STA FILNAME+2,Y
C030 4C28C0               JMP LOOP2        ;DO NEXT CHAR
C033      ;
C033 A050   TSAVE1        LDY #$50
C035 B9 C1  TSAVE2        LDA LOADER,Y     ;GET LOADER BYTE
C038 99 02B2              STA $02B2,Y      ;STORE IT TO SAVE
C03B 88                   DEY
C03C D0F9                 BNE TSAVE2       ;FOR ALL BYTES
C03E A9 00                LDA #$01
C040 AA                   TAX
C041 A8                   TAY
C042 20BAFF               JSR $FFBA        ;SET FILE DETAILS
C045 A900                 LDA #$19         ;LENGTH OF FILENAME
C047 A2FD                 LDX #<FILNAME    ;FILENAME LO
C049 A0C0                 LDY #>FILNAME    ;FILENAME HI
C04B 20BDFF               JSR $FFBD        ;SET NAME DETAILS
C04E A900                 LDA #$00
C050 85 2D                STA $2D
C052 A902                 LDA #$02
C054 85FC                 STA $FC          ;SAVE START HI
C056 A9AB                 LDA #$AB
C058 85FB                 STA $FB          ;SAVE START LO
C05A A9FB                 LDA #$FB         ;POINT TO START
C05C A204                 LDX #$04         ;SAVE END HI
C05E A003                 LDY #$03         SAVE LOADER FILE
C060 20D8FF               JSR $FFD8        ;SAVE LOADER FILE
C063 A903                 LDA #$03
C065 8D0203               STA $0302        ;RESET WARM START
C068 A984                 LDA #$84         ; VECTOR
C06A 8D0303               STA $0303
C06D A9FF                 LDA #$FF
C06F 85 2D                STA $2D
C071 A6 2C                LDX $2C
C073 A4 2D                LDY $2D
C075 A900                 LDA #$00
C077 20D8FF               JSR $FFD8
C07A      ;
C07A      ;       THE FAST SAVE ROUTINE
C07A      ;       STARTS HERE.
C07A      ;
C07A 20D8C0 SAVEIT        JSR WRTHDR       ;WRITE ALIGNMENT BYTES
C07D A5FB                 LDA $FB          ;GET START LO
C07F 48                   PHA
C080 20 D8C0              JSR WRTBYT       ;WRITE IT
C083 A5FC                 LDA $FC          GET START HI
C085 48                   PHA
C086 20 D8C0              JSR WRTBYT       ;WRITE IT
C089 A5 2C                LDA $2C          CALC END LO
C08B 20 D8C0              JSR WRTBYT       ;WRITE IT
C08E A5 2D                LDA $2D          ;GET END HI
C090 20 D8C0              JSR WRTBYT       WRITE IT
C093 A9 FF                LDA #$FF         ;ZERO CHECKSUM
C095 85 C8                STA $C8          SET PAGE OFFSET
C097 A0 00                LDY #$00
C099 A9 00                LDA #$00         ;ZERO LO BYTE
C09B 85 C7                STA $C7          ;GET A BYTE
C09D 20 D8C0 TSAVLOOP     JSR WRTBYT       ;WRITE IT
C0A0 A5 C7                LDA $C7
C0A2 C4 2D                CPY $2D          ;CHECK END OF SAVE
C0A4 D0 F9                BNE TSAVLOOP     ;NOT YET
C0A6 A5C8                 LDA $C8          ;GET CHECKSUM
C0A8 20D8C0               JSR WRTBYT       WRITE IT
C0AB 20D0C1               JSR WRTBIT       CLOSE OFF LAST BIT
C0AE A9 08                LDA #$08
C0B0 85 B7                STA $B7          ;UNBLANK SCREEN
C0B2 A9 00                LDA #$00
C0B4 8D02D0               STA $D002        ;STOP TAPE
C0B7 A9 C1                LDA #$C1         ;RESTART  IRQ
C0B9 8D 14 03             STA $0314        ;GET START HI
C0BC A5 FB                LDA $FB          ;STORE IT
C0BE 85 C7                STA $C7          GET START LO
C0C0 A5 FC                LDA $FC          ;STORE IT
C0C2 85C8                 STA $C8          RESET I/O
C0C4 20D2C0               JSR $C0D2        ;EXIT TO "READY."
C0C7 4C7A84               JMP $847A
C0CA      ;
C0CA A9A6   WRTHDR        LDA #$A6         ;BASIC ROM OUT &
C0CC 8D01 00              STA $01          ; START TAPE
C0CF A9 08                LDA #$08         ;BLANK SCREEN
C0D1 8D11D0               STA $D011        ;PAUSE FOR TAPE
C0D4 CA     HEADR1        DEX              ; TO GET TO FULL
C0D5 D0 FD                BNE HEADR1       ; SPEED
C0D7 CA                   DEX
C0D8 86 01                STX $01          ;DISABLE IRQ
C0DA 78                   SEI
C0DB A9A0                 LDA #$A0         ;INITIAL TIMER
C0DD 8D04DD               STA $DD04        ; VALUE FOR DELAY
C0E0 A900                 LDA #$00
C0E2 8D05DD               STA $DD05
C0E5 A919                 LDA #$19
C0E7 8D0EDD               STA $DD0E        START TIMER
C0EA A940                 LDA #$40
C0EC A040   HEADR2        LDY #$40         ;8,000000 FOR
C0EE 20F3C0               JSR WRTBYT       ALIGNMENT
C0F1 88                   DEY
C0F2 D0FB                 BNE HEADR2       WRITE 64 OF THEM
C0F4 A059                 LDA #$59         CALC A ALIGNMENT
C0F6 20F3C0               JSR WRTBYT       WRITE IT
C0F9 60                   RTS
C0FA
C0FA 8F8D   WRTBYT        STA $3D          ;STORE BYTE
C0FC 45 3D                EOR $3D          CHECKSUM
C0FE 85 3D                STA $3D
C100 A008                 LDA #$08         ;LOOP FOR 8 BITS
C102 A502                 STA $02
C104 26 3D  WBYTE1        ROL $3D          ;BIT INTO CARRY
C106 2A                   ROL A            WRITE THE BIT
C107 C6 02                DEC $02          DO NEXT BIT
C109 D0 F9                BNE WBYTE1
C10B 60                   RTS
C10C
C10C A270   WRTBIT        LDX #$70         ;ASSUME ZERO BIT
C10E 9002                 BCC WB T1        CARRY IS CLEAR
C110 A2FF                 LDX #$FF         SET FOR ONE BIT
C112 8E04DD               STX $DD04        SET TIMER
C115 A900                 LDA #$00
C117 8D05DD               STA $DD05        WAIT FOR TIMER
C11A A9 08                LDA #$08
C11C 2D0DD0 WB1T2         BIT $D0D         ;
C11F F0FB                 BEQ WB T2        ;
C121 A9 00                LDA #$00         DOUBLE WRITE BIT
C123 8D0DD0               STA $D0D         IN 65,0 REGISTER
C126 A9 08                LDA #$08         ;SHOW IT IS WORKING
C128 8D11D0               STA $D011
C12B A9A0                 LDA #$A0         ;START TIMER
C12D 8D0EDD               STA $DD0E        ;WAIT FOR TIMER
C130 A9 08                LDA #$08
C132 2D0DD0 WB1T3         BIT $D0D
C135 F0FB                 BEQ WB1T3
C137 A9A1                 LDA #$A1         ;TOGGLE WRITE BIT
C139 8D0DD0               STA $D0D         ; IN 65,0 REGISTER
C13C A900                 LDA #$00
C13E 8D0EDD               STA $DD0E
C141 A9 19                LDA #$19         ;START TIMER
C143 8D0EDD               STA $DD0E
C146 60                   RTS
C147
C147 78                   SEI
C148 A905                 LDA #$05         ;START TAPE
C14A 8501                 STA $01          ;DISABLE KEYBOARD
C14C A91F                 LDA #$1F
C150 8D00DD               STA $DD00
C153 8D03DC               STA $DC03
C156 A0E0                 LDA #$E0
C158 8D00DC               LDA $DC00
C15C A968                 LDA #$68         SET TIMER
C15E 8D04DC               STA $DC04
C161 A903                 LDA #$03
C163 8D05DC               STA $DC05        ;ENABLE TAPE IRQ
C166 A990                 LDA #$90
C168 8D0DDC               LDA $DC0D        SET IRQ VECTOR
C16B A951                 LDA #$51         TO POINT TO
C16D 8DFEFF               STA $FFFE        ; LOAD ROUTINE
C170 A983                 LDA #$83
C172 8DFFFF               STA $FFFF        ;SET NMI VECTOR
C175 A977                 LDA #$77         ; TO POINT TO
C177 8DFAFF               STA $FFFA        ; AN RTI
C17A A903                 LDA #$03
C17C 8DFBFF               STA $FFFB        CLEAR LOADED FLAG
C17F A900                 LDA #$00
C181 8502                 STA $02          ;WAIT FOR END OF LOAD
C183 58                   CLI
C184 4C0080               JMP $8000
C187
C187      ;       *=$02F3
C187      ;
C187 A983                 LDA #$83         ;RESET WARM START
C189 8D02 03              STA $0302        VECTOR
C18C A984                 LDA #$84
C18E 8D03 03              STA $0303
C191 4CE94F               JMP $FE94        ;RESET I/O
C194 8E5A8                WOR #$5A8,$02F8
C198
C198 932A20 FILNAME       TXT "S"          IRQ ENTRY POINT
C19A 48                   PHA
C19B 98                   TYA
C19C 48                   PHA
C19D A0 00                LDA #$0D5        ;GET TIMER HI BYTE
C19F A0 05                LDY #$05         ;RESTART TIMER
C1A1 8C 0DDC              STY $DC0E
C1A4 A902                 LDA #$02         ;FLIP BIT 1
C1A6 4A                   LSR A            ; AND SHIFT TO
C1A7 2A                   ROL A            CARRY
C1A8 A9 00                LDA #$00         ;MOVE BIT INTO
C1AA 2A                   ROL A            BYTE READ
C1AB 8D 00                STA $D00         ;WHEN BYTE READ
C1AE 90D7                 BCC B TOOT       NOT COMPLETE BYTE
C1B0 A008                 LDY #$08         ;ALIGNMENT
C1B2 C940   BITGOT        CMP #$40         INO
C1B4 D009                 BNE EX I         SET NEW ADDRESS
C1B6 8916                 LDA #$16
C1B8 8D63                 STA $D63
C1BA 88FE   EXI           LDA $8FE         GET READY FOR
C1BC 8589                 STA $89          A NEW BYTE
```

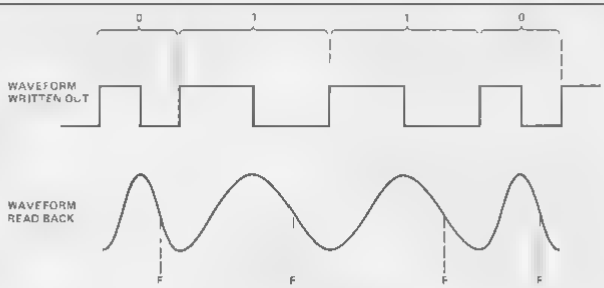

Figure 1. High speed tape waveform

Program Listing 1 (cont.)

```
C10C A0080C EXIT    LDA #$0C80          ;CLEAR IRQ
C10F 68             PLA
C110 A8             TAY
C111 68             PLA
C112 40             RTI                 ;EXIT IRQ
C113        ;
C113 C940           CMP #$40            ;MORE ALIGNMENT?
C115 F0F            BEQ EX1             ;YES
C117 C9FA           CMP #$FA            ;FINAL CHECK?
C119 F0B            BEQ BITGT2          ;YES
C11B A982           LDA #$82            ;GO BACK TO
C11D 838583         STA $0365           ; ALIGNMENT ROUTINE
C120 D0E6           BNE EX1
C122 A930   BITGT2  LDA #$30            ;SET NEW ADDRESS
C124 838583         STA $0365           ; TO READ IN LOAD
C127 A900           LDA #$00            ; ADDRESSES, CLEAR
C129 85D            STA $C1             ; CHECKSUM
C12B F0EB           BEQ EX1
C12D        ;
C12D 85F8           STA $F8             ;STORE LOAD ADDRESS
C12F E6F903         INC $0397           ;INCREASE STORE
C132 A597 03        LDA $0297           ; UNTIL 4 BYTES
C135 C9FF           CMP #$FF
C137 D0D7           BNE EX1             ;NOT YET
C139 A943           LDA #$43            ;STORE NEW ADDRESS
C13B 838583         STA $0365           ;FOR READING FILE
C13E D0C3           BNE EX1
C140        ;
C140 A000           LDY #$00
C142 91F8           STA ($F8),Y         ;STORE A BYTE
C144 45C1           EOR $C1             ;CALCULATE CHECKSUM
C146 85C1           STA $C1
C148 EE0C08         INC $0800           ;SHOW IT IS WORKING
C14B E6F8           INC $F8             ;INCREASE ADDRESS
C14D D0E4           BNE BITGT5
C14F E6FC           INC $FC
C151 A5F8   BITGT5  LDA $F8             ;END OF LOAD?
C153 C5FD           CMP $FD
C155 D0F5           BNE EX1             ;NOT YET
C157 A5FC           LDA $FC             ;NEW ADDRESS FOR
C159 838583         STA $0365           ;NEXCHUNK
C15C D0E6           BNE EX1
C15E        ;
C15E 85C2           STA $C2             ;STORE CHECKSUM
C160 A9FF           LDA #$FF            ;FLAG END OF LOAD
C162 8502           STA $02
C164 A982           LDA #$82            ;RESET BRANCH TO
C166 838583         STA $0365           ; ALIGNMENT
C169 A9FB           LDA #$FB
C16B 8D9703         STA $0297
C16E D094           BNE EX1
C170        ;
C170        ;*=$0200
C170        ;
C170 A502   PAUSE   LDA $02             ;WAIT FOR FILE
C172 F0FC           BEQ PAUSE           ; TO BACKGROUND LOAD
C174 A900           LDA #$00
C176 8402           STA $02
C178 A987           LDA #$87            ;
C17A 8D0            STA $01             ;RESET KERNAL ROM
C17C 4C:A02         JSR $E2F2
C17F        ;
C17F 206386         JSR $6663           ;CLR
C182 A5C1           LDA $C1             ;COMPARE CHECKSUMS
C184 C5C2           CMP $C2
C186 D003           BNE LOADERR         ;DIFFERENT ERROR
C188 4C7A84         JMP $847A           ;GO TO 'READY.'
C18B        ;
C18B A210   LOBERR  LDX #$10            ;'?LOAD ERROR'
C18D 4C37A4         JMP $A437           ;SEND ERROR
```

Program Listing 2

```
033C        ; FAST TAPE SAVE FOR THE 64.
033C        ;*****************************
033C        ;
033C        ;THIS ROUTINE WILL SAVE A PROGRAM
033C        ; TO TAPE SO THAT WHEN LOADED BACK
033C        ;IT WILL LOAD FASTER THAN THE
033C        ;1541 DISK DRIVE
033C        ;
033C        ; AN OPTION FOR AUTO-RUN IS
033C        ;INCLUDED.
033C        ;
0800        *=$C000
0800 A90B           LDA #$CBVVEC        ;CHANGE SAVE VECTOR
0802 8D3200         STA $0332           ; TO GO TO NEW
0805 A9CB           LDA #$CBVVEC        ; SAVE ROUTINE
0807 8D3303         STA $0333
080A 60             RTS
080B        ;
080B 48     SAVVEC  PHA                 ;SAVE OFF  A
080C A5BA           LDA $BA             ; GET DEVICE #
080E C007           CMP #$07            ;NUMBER 7?
0810 F004           BEQ TSAVE           ;YES
0812 68             PLA
0813 4CED F5        JMP $F5ED           ;DO NORMAL SAVE
0816        ;
0816 A539   TSAVE   LDA $39             ;GET SEC. ADDR.
0818 8D29C2         STA RUNFLG          ;FLAG FOR AUTO-RUN
081B A90F           LDY #$0F
081D A920           LDA #$20
081F 998D01 LOOP1   STA FLNAME,Y        ;BLANK FILENAME
0822 88             DEY
0823 10FA           BPL LOOP1
0825 A4B7           LDY $B7             ;GET FILENAME LENGTH
0827 C011           CPY #$11            ;GREATER THAN 16
0829 B002           BCS LOOP2           ;NO
082B A010           LDY #$10            ;ONLY 1ST 16 CHARS
082D 88     LOOP2   DEY
082E 3006           BMI TSAVE1
0830 B1BB           LDA ($BB),Y         ;GET FILENAME
0832 990C01         STA FLNAME,Y        ;STORE IT
0835 4C2D08         JMP LOOP2           ;DO NEXT CHAR
0838        ;
0838 A047   TSAVE1  LDY #$47            ;GET LOADER BYTE
083A B944C1 TSAVE2  LDA LOADER,Y        ;STORE IT TO SAVE
083D 91BC           STA ($BC),Y
083F 88             DEY
0840 10F7           BPL TSAVE2          ;FOR ALL BYTES
0842 A901           LDA #$01
0844 AA             TAX
0845 A8             TAY
0846 20BAFF         JSR $FFBA           ;SET FILE DETAILS
0849 A92E           LDA #$2E            ;LENGTH OF FILENAME
084C A2BC           LDX #<FLNAME        ;FILENAME LO
084E A0C1           LDY #>FLNAME        ;FILENAME HI
0850 20BDFF         JSR $FFBD           ;SET NAME DETAILS
0853 A900           LDA #$00            ;STOP NAME FROM BEING
0855 85B9           STA $B9             ;PRINTED ON SAVE
0857 A982           LDA #$82
0859 85FC           STA $FC             ;SAVE START HI
085B A9BC           LDA #$BC            ;POINT TO START
085D 85FB           STA $FB             ;SAVE START LO
085F A0FB           LDX #$FB            ;SAVE END LO
0861 A004           LDY #$04            ;SAVE END HI
0863 A003           LDA #$03            ;SAVE LOADER FILE
0865 20D8FF         JSR $FFD8
0868 A983           LDA #$83            ;RESET WARM START
086A 8D0203         STA $0302           ; VECTOR
086D A984           LDA #$84
086F 8D0303         STA $0303
0872 A941           LDA #$41
0874 8539           STA $39
0876 A000           LDY #$00
```

Program Listing 2 (cont.)

```
C078 A200              LDX #$00
C07A          ;
C07A          ;THE FAST SAVE ROUTINE
C07A          ; STARTS HERE.
C07A          ;
C07A 20C8C0            JSR WRTHDR   20C880    ;WRITE ALIGNMENT BYTES
C07D A52B              LDA $2B                ;GET START LO
C07F 48                PHA
C080 20FAC0            JSR WRTBYT   20FA80    ;WRITE IT
C083 A52C              LDA $2C                ;GET START HI
C085 48                PHA
C086 20FAC0            JSR WRTBYT   20FA80    ;WRITE IT
C089 A52D              LDA $2D                ;GET END LO
C08B 20FAC0            JSR WRTBYT   20FA80    ;WRITE IT
C08E A52E              LDA $2E                ;GET END HI
C090 20FAC0            JSR WRTBYT   20FA80    ;WRITE IT
C093 84FB              STY $FB                ;ZERO CHECKSUM
C095 A42B              LDY $2B                ;GET PAGE OFFSET
C097 A900              LDA #$00
C099 852B              STA $2B                ;ZERO LO BYTE
C09B B12B     TSAVLOOP LDA ($2B),Y            ;GET A BYTE
C09D 20FAC0            JSR WRTBYT   20FA80    ;WRITE IT
C0A0 C8                INY
C0A1 D002              BNE TSAVE3
C0A3 E62C              INC $2C
C0A5 C42D     TSAVE3   CPY $2D                ;CHECK END OF SAVE
C0A7 A52C              LDA $2C
C0A9 E52E              SBC $2E
C0AB 90EE              BCC TSAVLOOP           ;NOT YET
C0AD A5FB              LDA $FB                ;GET CHECKSUM
C0AF 20FAC0            JSR WRTBYT             ;WRITE IT
C0B2 200EC1            JSR WRTBIT             ;CLOSE OFF LAST BIT
C0B5 A91B              LDA #$1B
C0B7 8D11D0            STA $D011              ;UNBLANK SCREEN
C0BA A937              LDA #$37               ;STOP TAPE
C0BC 8501              STA $01
C0BE 58                CLI                    ;RESTART IRQ
C0BF 68                PLA                    ;GET START HI
C0C0 852C              STA $2C                ;STORE IT
C0C2 68                PLA                    ;GET START LO
C0C3 852B              STA $2B                ;STORE IT
C0C5 2084FF            JSR $FF84              ;RESET I/O
C0C8 4C74A4            JMP $A474              ;EXIT TO 'READY.
C0CB          ;
C0CB A906     WRTHDR   LDA #$06               ;BASIC ROM OUT &
C0CD 8501              STA $01                ; START TAPE
C0CF A90B              LDA #$0B
C0D1 8D11D0            STA $D011              ; BLANK SCREEN
C0D4 CA       HEADR1   DEX                    ;PAUSE FOR TAPE
C0D5 D0FD              BNE HEADR1             ; TO GET TO FULL
C0D7 88                DEY                    ; SPEED
C0D8 D0FA              BNE HEADR1
C0DA 78                SEI                    ; DISABLE IRQ
C0DB A9A0              LDA #$A0               ;INITIAL TIMER
C0DD 8D04DD            STA $DD04              ; VALUE FOR DELAY
C0E0 A900              LDA #$00
C0E2 8D05DD            STA $DD05
C0E5 A919              LDA #$19
C0E7 8D0EDD            STA $DD0E              ;START TIMER
C0EA A040              LDY #$40               ;%01000000 FOR
C0EC A940     HEADR2   LDA #$40               ;ALIGNMENT
C0EE 20FAC0            JSR WRTBYT
C0F1 88                DEY                    ;WRITE 64 OF THEM
C0F2 D0F8              BNE HEADR2
C0F4 A95A              LDA #$5A               ;CHECK ALIGNMENT
C0F6 20FAC0            JSR WRTBYT             ;WRITE IT
C0F9 60                RTS
C0FA          ;
C0FA 85BD     WRTBYT   STA $BD                ;STORE BYTE
C0FC 45FB              EOR $FB                ;CHECKSUM
C0FE 85FB              STA $FB
C100 A908              LDA #$08               ;LOOP FOR 8 BITS
C102 85A3              STA $A3
C104 26BD     WBYTE1   ROL $BD                ;BIT INTO CARRY
C106 200EC1            JSR WRTBIT             ;WRITE THE BIT
C109 C6A3              DEC $A3
C10B D0F7              BNE WBYTE1             ;DO NEXT BIT
C10D 60                RTS
C10E          ;
C10E A240     WRTBIT   LDX #$40               ;ASSUME ZERO BIT
C110 9002              BCC WRIT1              ; CORRECT ASSUMPTION
C112 A290              LDX #$90               ;SET FOR ONE BIT
C114 8E04DD   WRIT1    STX $DD04              ;SET TIMER
C117 A900              LDA #$00
C119 8D05DD            STA $DD05
C11C A901              LDA #$01               ;WAIT FOR TIMER
C11E 2C0DDD   WRIT2    BIT $DD0D
C121 F0FB              BEQ WRIT2
C123 A501              LDA $01                ;TOGGLE WRITE BIT
C125 4908              EOR #$08               ; IN 6510 REGISTER
C127 8501              STA $01
C129 EE20D0            INC $D020              ;SHOW IT IS WORKING
C12C A919              LDA #$19               ;START TIMER
C12E 8D0EDD            STA $DD0E
C131 A901              LDA #$01               ; WAIT FOR TIMER
C133 2C0DDD   WRIT3    BIT $DD0D
C136 F0FB              BEQ WRIT3
C138 A501              LDA $01                ;TOGGLE WRITE BIT
C13A 4908              EOR #$08               ; IN 6510 REGISTER
C13C 8501              STA $01
C13E A919              LDA #$19               ; START TIMER
C140 8D0EDD            STA $DD0E
C143 60                RTS
C144          ;
C144          ;THE LOADER STARTS HERE
C144          ;
C144 AD20D0   LOADER   LDA $D020              ;SAVE BORDER COLOUR
C147 85FE              STA $FE
C149 A9A4              LDA #$A4               ;RESET WARM START
C14B 8D0303            STA $0303              ; VECTOR
C14E A983              LDA #$83
C150 8D0203            STA $0302
C153 205C03            JSR $035C              ;FAST LOAD THE FILE
C156 A5FE              LDA $FE
C158 8D20D0            STA $D020              ;RESTORE BORDER COLOUR
C15B A937              LDA #$37               ;STOP THE TAPE
C15D 8501              STA $01
C15F 58                CLI                    ;RESTORE IRQ
C160 A91B              LDA #$1B               ;UNBLANK SCREEN
C162 8D11D0            STA $D011
C165 2084FF            JSR $FF84              ;RESET I/O
C168 A5FC              LDA $FC                ;COMPARE CALCULATED TO
C16A C5FB              CMP $FB                ; LOADED CHECKSUM
C16C D015              BNE LODERR             ;DIFFERENT, ERROR
C16E 2033A6            JSR $A633              ;CLR
C171 ADE903            LDA $03E9              ;GET AUTO-RUN FLAG
C174 F00A              BEQ EXIT               ;NO RUN
C176 208EA6            JSR $A68E              ;SET CHRGET POINTER
C179 A900              LDA #$00
C17B 859D              STA $9D                ;FLAG RUN MODE
C17D 4CAEA7            JMP $A7AE              ;RUN
C180          ;
C180 6C0203   EXIT     JMP ($0302)            ;WARM START
C183          ;
C183 A21D     LODERR   LDX #$1D               ;'?LOAD  ERROR'
C185 4C37A4            JMP $A437              ;SEND ERROR
C188          ;
C188 8BE3              WOR $E38B              ;ERROR LINK
C18A 3C02              WOR $023C              ;WARM START LINK
C18C          ;
C18C 202020   FLNAME   TXT "
C19C          ;
C19C                6 SPACES
C19C          ;
C19C                *=$035C
C19C          ;
C19C 209203            JSR $0392              ;READ HEADER
C19F 20C503            JSR $03C5              ;READ A BYTE
C1A2 A8                TAY                    ;LOAD LO
C1A3 A900              LDA #$00
C1A5 85C1              STA $C1
C1A7 20C503            JSR $03C5              ;READ A BYTE
C1AA 85C2              STA $C2                ;LOAD HI
C1AC 20C503            JSR $03C5              ;READ A BYTE
C1AF 852D              STA $2D                ;END LO
C1B1 20C503            JSR $03C5              ;READ A BYTE
C1B4 852E              STA $2E                ;END HI
C1B6 20C503   TLOAD1   JSR $03C5              ;READ A BYTE
C1B9 91C1              STA ($C1),Y            ;STORE IT
C1BB 45FC              EOR $FC                ;CALCULATE CHECKSUM
C1BD 85FC              STA $FC
C1BF C8                INY
C1C0 D002              BNE TLOAD2
C1C2 E6C2              INC $C2
C1C4 C42D     TLOAD2   CPY $2D                ;CHECK END OF LOAD
C1C6 A5C2              LDA $C2
C1C8 E52E              SBC $2E
C1CA 90EA              BCC TLOAD1             ;NOT YET
C1CC 20C503            JSR $03C5              ;READ CHECKSUM
C1CF 85FB              STA $FB
C1D1 60                RTS
C1D2          ;
C1D2          ;*=$0392
C1D2          ;
C1D2 A907              LDA #$07               ;START TAPE
C1D4 8501              STA $01
C1D6 A90B              LDA #$0B               ;BLANK SCREEN
C1D8 8D11D0            STA $D011
C1DB CA       RHEAD1   DEX                    ;PAUSE FOR TAPE TO
C1DC D0FD              BNE RHEAD1             ; REACH FULL SPEED
C1DE 88                DEY
C1DF D0FA              BNE RHEAD1
C1E1 78                SEI                    ;DISABLE IRQ
C1E2 84FC              STY $FC                ;ZERO CHECKSUM
C1E4 8C05DC            STY $DC05              ;SET TIMER HI
C1E7 A9F8              LDA #$F8
C1E9 8D04DC            STA $DC04              ;SET TIMER LO
C1EC A200              LDX #$00
C1EE 20D303   RHEAD2   JSR $03D3              ;READ A BIT
C1F1 26BD              ROL $BD                ;INTO BYTE
C1F3 A5BD              LDA $BD                ;ALIGNED?
C1F5 C940              CMP #$40
C1F7 D0F5              BNE RHEAD2             ;NOT YET
C1F9 20C503   RHEAD3   JSR $03C5              ;READ A BYTE
C1FC C940              CMP #$40               ;IS IT 64?
C1FE F0F9              BEQ RHEAD3             ;YES
C200 C95A              CMP #$5A               ;ALIGNMENT CHECK?
C202 D0EA              BNE RHEAD2             ;NO
C204 60                RTS
C205          ;
C205          ;*=$03C5
C205          ;
C205 A901              LDA #$01
C207 85BD              STA $BD
C209 20D303   GBYTE1   JSR $03D3              ;READ A BIT
C20C 26BD              ROL $BD                ;INTO BYTE
C20E 90F9              BCC GBYTE1             ;COMPLETE BYTE
C210 A5BD              LDA $BD
C212 60                RTS
C213          ;
C213          ;*=$03D3
C213          ;
C213 A910              LDA #$10               ;WAIT FOR BIT
C215 2C0DDC   GBIT1    BIT $DC0D
C218 F0FB              BEQ GBIT1
C21A AD0DDC            LDA $DC0D              ;GET BIT
C21D 48                PHA
C21E A919              LDA #$19               ;START TIMER
C220 8D0EDC            STA $DC0E
C223 68                PLA
C224 EE20D0            INC $D020              ;SHOW IT IS WORKING
C227 4A                LSR A                  ;MOVE BIT INTO CARRY
C228 60                RTS
C229          ;
C229          ;*=$03E9
C229          ;
C229 00       RUNFLG   BYT 0
```

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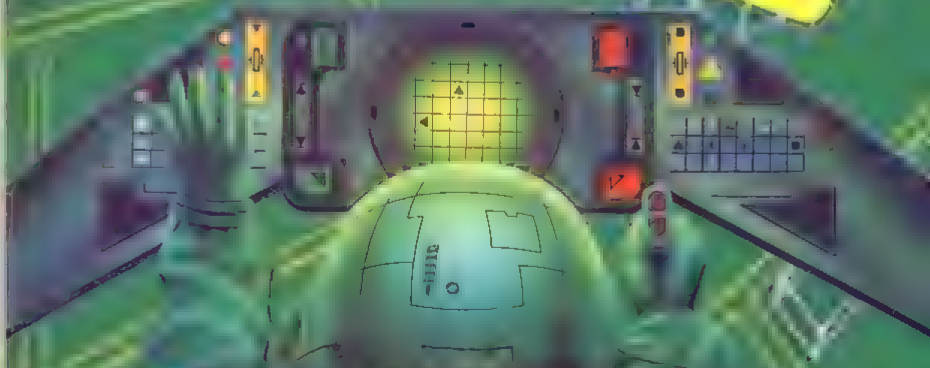

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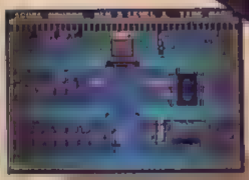

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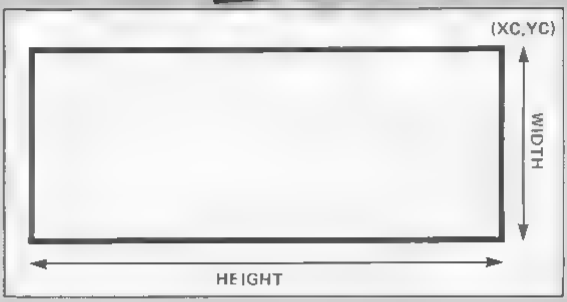

GREETINGS FELLOW 64 OWNERS, HERE are some more graphics wheezes to add that bit of power to your elbows. First, however, it's groveling time Remember part one of this series? You may have noted a POKE to location 1006 in the demonstration. Much to my embarassment, I didn't tell you what it does. It holds the number of shifts executed when you call the roll routines. A value of one will roll the design one pixel, a value of two rolls it two pixels, etc Values greater than three aren't too helpful, but the use of this register will make your efforts that little bit more interesting

This month I want to deal with graphics windows. A window is a definable area of the screen which can be manipulated independently of the rest of the screen The real value of windows is in the generation of menus and text games such as adventures.

As usual, the software is given as a Basic loader in listing one. The code sits at $C000 so it will unfortunately clash with the character routines – ab,ect apologies but such is life

The first problem to resolve is how to define a window Consider Figure 1 The rectangle represents a window of width W characters and height H units somewhere on the screen The top left hand corner is fixed by the co-ordinates XC and YC These four values are all that is necessary to specify the window. The machine code allows you to reserve and access up to 10 windows – numbered 0 to 9 Each window is defined in four tables in terms of co-ordinates of the top left hand corner and the height and width. The command for specifying a window has the syntax

SYS 49155,WN,XC,YC,W,H

WN is the window number and the other parameters are as specified earlier. It is important that you set up a window before manipulating it. When the program is set up the window tables contain zero and any action on an un-defined window will, at best, corrupt your Basic program so be warned!!

What can you do with the window? The next command has two forms depending on what you wish to do. A flag decides your action and the syntax. The first form will fill the window with a specified character CH

SYS 49158,WN,0,CH

i.e. the flag has a zero value. A non-zero flag simply reverses the contents of the window·

SYS 49158,WN

If you use the fill command with a value of CH equal to 32, the window will be cleared

Finally, you can scroll the contents of the screen To maintain compatibility with the normal 64 operation, the scrolling is upwards with the bottom line of the window being filled with blanks. The syntax of this command is.

SYS 49152,WN

To help you see what these routines will do, I've given two demonstrations The first shows the manipulation of three windows at once Since the window scrolls upwards, you must somehow print text at the bottom line. In my experience, the use of cursor control codes and TAB are both inelegant and tiresome It's far better to use a routine in the 64's Kernal The following line will do this.

POKE 781,Y POKE 782,X POKE 783,0 SYS 65520

where X and Y are the co-ordinates of the point to which you want to move the cursor Line 230 in the demo does this

The second demonstration uses randomly created windows to produce a pattern

I have included a degree of checking in the routine so that some illegal values (e.g. width 40 or height 25) will be rejected. Not all possibilities are catered for and it's up to you to ensure that silly values are not generated in your program.

The routines should be of most value to adventure freaks since it is simple to create two or three text windows with independent scrolling

Now, I want to deal with a feature which the BBC, C16 and Spectrum have in common The ability to use flashing characters The simple way to implement this is to use the attribute of each character to hold a flash flag. This is not simple to do on the 64 because there is no spare bit in the video matrix and it isn't easy to use the top four bits in the colour matrix. My solution is to let you select a colour to flash. This colour is kept in location 1000. The routine is called every 50th of a second by the IRQ interrupt The screen is scanned every 25 interrupt calls, so that the flash rate is about twice a second The routine scans the colour matrix and inverts every character of the specified colour. This routine is given in Listing two and a demonstration in demo three

Owners with new ROM 64s should take a little care. These machines fill the colour matrix with the current colour each time the screen is cleared If the current colour is the flash colour, the whole screen will flash. Demo three shows how to use the routine

To turn off the character flash, simply enter:

SYS 52736

That's all for this time, see you again next month. Happy hacking!

Demonstration 1

```
0 REM DEMONSTRATION 1
1 REM
10 POKES3281 1
20 C$= ********************
30 DATA 0,0,3,10
40 DATA 15,8,9,12
50 DATA 5,3,10,10
60 FOR WN=0TO2: READ X(WN),Y(WN),W
I(WN ,HI WN
70 NEXT
80 FOR WN=0TO2
90 SYS 12*4096+3,WN,X(WN),Y(WN),WI
 WN ,HI WN
100 NEXT
110 FOR WN=0TO2
120 CO=RND(1)*16:IFCO=1THEN120
130 POKE646,CO
140 IFWN=0ORWN=1 THEN GOSUB 190 PR
INTLEFT$(C$,WI(WN)) SYS12*4096 WN
150 IFWN=2THENSYS12*4096+6,WN,0,RN
D 1 *256
160 IF RND(1)<.5THEN SYS 12*4096+6
 WN,1
170 NEXT
180 GOTO 110
190 POKE781,Y(WN)+HI(WN  1  POKE78
2 X(WN) POKE783,0 SYS65520 RETURN
```

Demonstration 2

```
0 REM DEMONSTRATION 2
1 REM
10  S=INT(RND 1 *20)+1
20 WI=INT(RND(1)*20)+1
30 YS=INT(RND(1)*12)+1
40 HI=INT(RND(1)*12)+1
50 SYS12*4096+3,1,XS,YS,WI,HI
60 SYS12*4096+6,1,0,RND(1)*128
70 SYS12*4096+6,1,1:GOTO10
```

Demonstration 3

```
10 REM DEMONSTRATION 3
20 REM
30 SYS 52736: REM TURN THEM ON
40 POKE 1000,1 :REM WHITE TO FLASH
50 PRINT"[CLEAR][CYAN]THIS [WHITE]
IS[YELLOW] A [WHITE]DEMONSTRATIONC
c 7] OF  [WH
ITE]FLASHING[c 8]    CHARACTERS"
```

Listing 1

```
0 REM LISTING 1
1 DATA76,9,192,76,114,192,76,133,1
93,32 238 192 165,20,141,232,3,32
210,192
2 DATA32,29,193,24,165,163,105,40,
133,167,165,164,105,0,133,168,24,1
65 169
3 DATA105,40,133,176,165,170,105,0
 133,177 174,92,193,172,91,193,136
 177,167
4 DATA145,163,177,176,145,169,136,
16 245,202 240,28 24 165 163,105 4
0,133
5 DATA163,144,2,230,164,24,165,167
,105,40,133,167,144,2,230,168,32,6
,193,76
6 DATA52,192,172,91,193,136,169,32
,145,163,169,1,145,169,136,16,245,
96,32
7 DATA238,192,165,20,201,10,176,64
,141,232,3,32,238,192,172,232,3,16
5 20,201
8 DATA41,176,49,153,93,193,32,238,
192,172,232,3,165,20,201,25,176,34
,153 103
9 DATA193,32,238,192,172,232,3,165
,20,201,41,176,19,153,113,193,32,2
38,192
```

Listing 2

```
0 REM LISTING 2
1 DATA169,25,141,233,3,120,169,79,
141,20,3,169,206,141,21,3,88,96,16
9,0,133
2 DATA251,169,216,133,252,160,0,17
7,251,41,15,205,232,3,208,17,165,2
51,133
3 DATA253,56,165,252,233,212,133,2
54,177,253,73,128,145,253,230,251,
208,2
4 DATA230,252,165,251,201,232,240,
3,76,28,206,165,252,201,219,240,3,
76,28
5 DATA206,96,206,233,3,208,6,169,2
5,141,233,3,32,18,206,76,49,234,23
8
6 FORI=52736TO52831
7 READX T=T+X
8 POKE I,X:NEXT
9 IFT<>13738THENPRINT"ERROR IN DAT
A"
10 REM
11 REM FLASHING CHARACTERS ROUTINE
```

```
10 DATA172,232,3,165,20,201,26,176
,4,153,123,193,96,169,195,160,192,
32,30
11 DATA171,96,73,76,76,69,71,65,76
,32,86,65,76,85,69,63,0,172,232,3,
185,93
12 DATA193,141,89,193,185,103,193,
141,90,193,185,113,193,141,91,193,
185,123
13 DATA193,141,92,193,96,32,253,17
4,32,138,173,32,247,183,96,165,169
,24,105
14 DATA40,133,176,165,170,105,0,13
3,177,96,24,165,169,105,40,133,169
 144 2
15 DATA230,170,24,165,176,105,40,1
33,176,144,2,230,177,96,169,0,133,
163,169
16 DATA4,133,164,174,90,193,240,16
,24,165,163,105,40,133,163,165,164
 105,0
17 DATA133,164,202,208,240,174,89,
193 240 14,24,165,163,109 89,193 1
93,163
18 DATA165,164,105,0,133,164,165,1
63,133,169,165,164,24,105,212,133,
170,96
19 DATA10,2,10,10,0,5,0,0,0,0,0,0,
0,0,5,0,0,0,0,0,0,0,5,5,0,0,0,
0,0,0
20 DATA0,0,5,5,0,0,0,0,0,0,0,0,32,
238,192,165,20,141,232,3,32,238,19
2,165
21 DATA20,141,234,3,208,8,32,238,1
92,165,20 141,233,3,32,210,192,32,
29,193
22 DATA162,0,160,0,32,204,193,200,
204,91,193,240,3,76,169,193,24,165
,163,105
23 DATA40,133,163,165,164,105,0,13
3 164,232 236,92,193 240,3 76 167
193,96
24 DATA173,234,3,208,5,173,233,3,1
45,163,201,1,208,6,177,163 73,128,
145,163
25 DATA96
26 REM
27 REM WINDOW GENERATOR C64
28 REM A + M ASSOCIATES 1985
29 REM
30 FOR I = 49152 TO 49632
31 READ X: T = T + X
32 POKE I,X
33 NEXT
34 IF T<>55680 THEN PRINT"ERROR IN
 DATA"
```

COMPETITION

Want to get your C64 on line? Do you feel the need to communicate with other 64 owners? Well you could win one of 10 Commodore modems that we are giving away in this month's competition.

The rules

ENTRIES WILL NOT BE ACCEPTED FROM employees of Argus Specialist Publications, Commodore Business Machines and Alabaster Passmore and Sons. This restriction also applies to employee's families and agents of the companies.

The how to enter section forms part of the rules. The Editor's decision is final and no correspondence will be entered into.

How to enter

There are a few differences between the two pictures. Study them carefully and circle the differences on the picture attached to the coupon. Fill in the coupon clearly and seal the picture and coupon in an envelope. Write clearly the number of differences you found on the back of the envelope.

Post your entry to Modem Competition, Your Commodore, No 1 Golden Square, London W1R 3AB. The closing date is first post on Thursday, 31st November 1985. You may enter as many times as you like but each entry must be on an official coupon – not a copy – and sealed in a separate envelope.

Important: Please follow closely the guidelines on entering – incomplete coupons and entries with no numbers on the back cannot be considered. If you are a winner, the coupon will act as a label for your prize so clear writing is essential.

"Darling its been on that phone all day

"Darling its been on that phone all day

ENTRY FORM

Name

Address

Post Code

Age . . Occupation ....

Please complete the following tie breaker

I would use my Commodore modem to


THE COUNTDOWN HAS BEGUN
CRITICAL MASS
From DURELL
Commodore 64
Spectrum
R.R.P. £8.95
DURELL sales dept.,
Castle Lodge, Castle Green, Taunton TA1 4AB

Peter Thomas has been [illegible] exercising his brain on Ocean's Summer Games II. His results are not good. Read on...

FOR THOSE OF YOU, LIKE ME, WHO think that physical exercise is moving the car an extra yard or so from the front door each morning but who are mentaly capable of giving Daley Thompson and Steve Cram a run for their money, *Summer Games II* is just perfect.

Owners of the original *Summer Games* – now world leaders in the pole vault, dab hands at the full tuck dive, champions in the 4 × 400 metres relay and challenging Carl Lewis's 100 metre record – beware! If you have thrown in the towel in the freestyle relay and consider the gymnastics and sheet shooting difficult to master, rest assured that you can sit back and relax with Summer Games II – because it's twice as difficult.

You start with a simple hop, step and jump in the triple jump and if you don't fall head first in the sand you can watch an action replay of your successful soar across the sand while the appreciative crowd applauds.

Oarsmen and women among you can tackle the single sculls rowing and pit your skill against your friends, the computer or the clock. The split screen makes this event very exciting and realistic.

After the water you return to dry land for the javelin where a combination of speed, timing and power sees the javelin fly through the air across the screen. Again a good throw gains appreciation from the crowd.

The equestrian event brought back memories of pony trekking on Dartmoor when again I seemed to spend more time on the ground than on the horse. Timing is essential if you don't want an early ducking in the water jump.

Once you've had enough of horsing around you can attempt the high jump. I'm not sure whether there was a bug in my version of the game or whether I'm just not cut out for the high jump, but I only managed to get over the bar once and that was on the lowest level.

If you've got a grudge against someone then you'll love the fencing. Now you've got your chance to flex your foil and battle it out with your opponent. Control is a little difficult but after some practice, and a few beatings, you'll get used to it.

If you find that you have troubie staying on a tricycle then the cycling event is certainly not one for you. Rotating your joystick moves the man's legs on the pedals. If you don't move your joystick at a steady pace then you'll find yourself getting nowhere and see your opponent disappear towards the finishing line.

Kayaking is certainly not an event to be rushed. You must guide your kayak down the white water while passing through a number of gates. Some gates must be passed through forward, others backwards, some you even have to guide your kayak through while going upstream. This is certainly an event which takes a lot of concentration. You'll soon figure out how to guide your craft but getting through the gates is a different matter.

In each event you strive for gold, silver or bronze medals all the time attempting new heights of glory to become the world record holder.

Choose which country to represent out of a possible 18, put on your sportswear and prepare for *Summer Games II*. Alternatively, lock your bedroom door switch on your computer and practice each event for half an hour while going on a strict diet until you are ready for the next ma or championship.

P.T.

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GOLD EDITION

RUPERT

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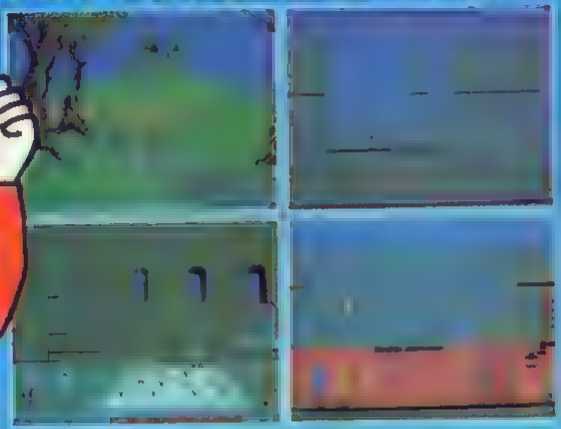

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SENSE OF ADVENTURE

Runecaster risks life and limb yet again in order to bring you his column.

AS I AM SURE YOU ALREADY KNOW, adventure games can cost quite a lot of money. Generally speaking the more expensive games are disc based and provide you with many hours of pleasure for your money. The higher middle range of tapes (around £10 plus) seem to be the ones that sometimes make you think.

On the other hand there are a number of bargains around. My local Spectrum Chain shop had a couple of good buys. One would, be loosely (very loosely) classed as an arcade adventure – *Mystic Mansion* – and the other, a well presented text adventure, was *Aliard's Tomb*. Respectively, £2.99 and £1.99.

The first, US Gold, hardly comes within the range of this column but is worth looking at, especially if you have young children around. It is a 20 level, find the treasures, avoid the monsters type of game with a good difficulty grading – Adult, Teenager or Child.

The second, *Aliard's Tomb*, is a neat little adventure that does not appear to have any hideous inconsistencies and at the price is well worth buying. Fairly conventional scenario – dark dungeons, in which you have to find the aforesaid Tomb, solving several ingenious puzzles in the process.

Keep your eyes skinned for these and other 'cheapies' – they are often either reissues or are stock from defunct software houses. You will not find *Exodus: Ultima III*, *The Hobbit* or *Eureka* but may well find something to keep you interested.

Kitchen Scientist

'Down in the kitchen' something turned or rather squeaked in the wan probably the lady of the house using one of those reusable shopping list boards you know the type – plastic-faced and supplied with a water soluble ink marker. Make notes throughout the week on what is required & buy them on Saturday and wipe the 'slate' clean on Sunday.

What has this to do with playing adventures? Well, a firm in Wales, Mapit, have produced a plastic reusable Map Maker. It is A3 size (two pages of Your Commodore) and has a 13×11 grid of 14×27mm rectangles printed on it – just the thing for mapping all your trips elsewhere! There is space at the top of the board to make 'vital notes' and the pens supplied have a fine enough point to enable all the vital facts of a location to be recorded in the space provided.

The Map Maker costs £3.49 and there also is a range of suitable pens in various colours at 99p each. A little more expensive than scrap paper but as we approach Christmas, Mapit can be found at 166 Robert Street, Ynysybwl (perhaps we should have a checksum on that!), Mid Glamorgan CF37 3EA.

But, the great Crystal was stolen. The Red Moon is the story of how a Magician (you!) recovered this fabulous gem and restored hope to the World.

Not only are there hundreds of scene-setting pictures but there are also the long and descriptive texts that have always been the hallmark of Level Nine games. Read, and wonder at it all. How do they get it all into our computer's memory! The pictures are good, better than the rather surrealistic landscapes of Return to Eden. They are certainly not high, hi-res works of art but serve the very important purpose of visually triggering recognition of your present location.

As with all Level Nine games (and most other good adventures!) it is important to keep a careful map of your progress. There is a temptation when recognizable pictures are displayed, to skip the mapping procedures. Fight this temptation – draw a map!

Unlike many games where an apparently insoluble puzzle bars your progress within a few steps of your entry point, *Red Moon* has plenty of locations for even the absolute novice to explore right from the start. Do not think that this implies a beginners game – even accomplished adventurers will be gnashing their teeth on occasions. For those that get totally lost and confused, Level Nine offers the best hint sheets in the business. These are so laid out that it is not easy to read something you wish you weren't.

Artefacts found soon after entry will include the inevitable lamp for subsequent exploration of dark and dangerous places. Dangerous! Yes! There are a number of decidedly aggressive creatures just waiting for you to stumble by. To be successful you will have to fight them. Bare hands are not to be recommended, find a useful weapon and better still some armour to protect you. You start your foray into this other world with some 50 'hit points', it is surprising how quickly these can be used up. The use of the Magik is permitted, even encouraged. To implement these spells you must enter a command of the type 'CAST ZAP'. Each spell may only be cast successfully if you have the object that is the 'focus' for that particular spell.

'CAST ZAP' is used to magically attack an enemy but you must have the jewelled dagger for it to work. Casting spells also uses up some of your 'hit points', so try not to be too extravagant with them.

SAVE and RESTORE your current position are also counted as spells! In this case no 'focus' is required but it still uses up your 'hit points'. A clever dodge this, as it stops us making dozens of 'safety saves'.

Neither can you cast a spell successfully if you have iron about your person (or at that location). You cannot fault the logic, even if it is a little frustrating at times!

The C64 tape version utilizes a 'rapid loader' and takes just less than three minutes to load this massive program. So, even though disk versions are usually available the gain is fairly small.

Level Nine is to be congratulated on keeping standards at such a high level for such an extended time. Good luck and roll on the next one – but please give us a little time to solve this one first!

Over the moon

Level Nine does it again. *Red Moon* is the latest from Britain's number one adventure software house. As usual the products are available for a number of computers but of interest to us here is the C64 version.

Over 200 pictures can be found as you explore the Magik's land of the Red Moon. Level Nine seems to improve with age, not only can you turn the pictures off, saving the 'drawing' time, but with this program you can even type in commands while the pictures are being created on the screen!

The *Red Moon* is about a land where Magik works, albeit nowhere nearly as strongly as in the past. In the past the moon was crimson red and the source of all the great Magiks. As the moon faded to the grey we know today, so the Magik waned. A great conclave of Magicians created a substitute – the Red Moon Crystal. This was mounted in the Moon Tower of Baskalos and shone out over the kingdom, maintaining an island of Magik and enlightened Civilization.

Sore fingers...

Although the range of good software grows as time goes by, there are always some people who like to 'do their own thing'. Obviously if you get that good at it we will start reading about your work in this column!

Many others spend enjoyable hours pounding away at their keyboards typing in programs gleaned from magazines and books. This can often be very, very good programming practice. This is the way to learn how a program works (often the hard but permanent way) by having to debug it!

It is also often possible to see how to improve on the published listing. The original programmer was probably heavily involved in his program, whereas you will be looking at each section in a fresh light.

There are already several books on the market that will help you write adventure games on the Commodore 64. On the other hand, new ideas are always welcome, you never know what new routines you may find! Book is nowadays are rarely cheap but in terms of time spent at your computer are probably much cheaper than the average piece of software. Two offerings have come our

way recently, one American and one British.

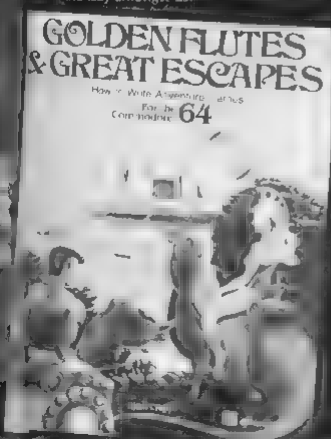
The first is: *Golden Flutes & Great Escapes* by Dekon T Horn, published by Dilithium Press, ISBN 0-88056-051-7. There are over 200. Four complete listings are given together with hints, tips, flow charts and possible variations to the game play.

The book is written in clear English (American?) and presents the writing of adventure games in a modular form that should be understood by the reader. The listings are in BASIC and are for text only displays. Although I have not keyed any of them in, they look reasonably interesting if you are just starting out along this path. They should give you plenty to think about. Dilithium Press Publications are distributed in the United Kingdom by Holt Saunders Ltd, 1, St Anne's Road, Eastbourne BN21 3UN. Holt Saunders has a number of titles dealing with computers and computing. A list of these is obtainable from the above address.

The second book is *Castles and Kingdoms* by Bob Liddil, published by Virgin Books, ISBN 0-86369-094-7 = 186 pages, cost £5.95. This book is quite different to the one above as no explanation of each individual program is given.

Listings for 15 (!) different adventures are given together with 4 pages (210×265mm) or so to set the scene for each. Again the programs are in BASIC and are clearly set out for you to type in. The games are presented for you to play rather than learn from but the inevitable debugging is bound to teach you something.

Both books appear to offer good value for money = look out for them and let us know how you get on! Both publications offer copies of the games on cassette for the lazy amongst us!



Not for the gentle...

Do you remember Dallas by US Gold? It appeared in this country last year and was acclaimed by many reviewers at the time. If you have not played it, try to get your computer shop to demonstrate it for you. It is disc based only and has excellent graphics that are called from the disc as you proceed.

What made me think of Dallas is a recent issue from Activision, Mindshadow. It too is disc based and also has good graphics again called from the disc. The plot is novel too, you awake on a desert island, not knowing who you are.

The aim of the game is to discover your own identity and who left you to perish. As the story unfolds, you find yourself travelling around the world in search of the answers. The program is well conceived and presented, the puzzles are good and the use of the function keys well thought out.

The only thing I have against Mindshadow is the underlying need to behave in a somewhat underhand manner to succeed! As a barbarian clobbering trolls or a thief stealing deftly through dungeons I have no qualms but striking out with no provocation or stealing from a sleeping tramp? I dunno. That gripe apart this is a good adventure and the use of the function keys make it very easy to play. The most used commands are immediately at your fingertips: SAVE, LOAD, REPEAT, HELP, DROP, GET, QUICKSAVE and QUICKLOAD are all function key commands.

SAVE and LOAD allow you the option of 10 different game positions. These may be overwritten at any time you change your mind throughout the game. QUICKSAVE and QUICKLOAD are particularly nice features as they allow you to save your present position temporarily at any time you think your next move may be your last!

HELP enlists the assistance of a wise old bird = the Condor = why a Condor I do not know but he can be darn useful! His help can only be given three times. He makes use of his knowledge carefully. You can of course start from scratch and use the help gained in previous games to reach your last position, then get three new HELPs!

Although there are some devious parts in Mindshadow, it is not a very difficult game to play. The number of locations in each section is not large and although mapping should always be an adventurer's first line of attack it is not always necessary here. You must solve each section before you can proceed, so at least you know how you are doing! If you are unable to go anywhere else then you know you have missed something!

For all that, I still do not know who I am. There are no prizes to anyone making any unkind suggestions!

SMALL PRINT

Barry Miles has had a look at the C.Itoh Dot Matrix Printer — and gone overboard.

THIS PRINTER IS BEING SOLD AS A competitor to Commodore printers. It is fitted with Din sockets and an internal interface making it directly plug compatible with Commodore machines.

In addition it responds to Commodore's control codes and secondary addresses. It is as if the Commodore range of printers has been extended. You can also switch the machine into an Epson FX80 emulation mode. It is immediately apparent that serious thought must be given to this printer.

First impressions are very good. This is not a hernia-inducing machine. It weighs a mere 8.375 pounds and comes in a box with a nylon carrying handle, which emphasises its lightness. In fact it could probably be carried in a normal briefcase.

Additionally first examination of the machine shows that very careful thought has been given to its design. It is both a tractor and friction-feed printer, and has a carefully designed paper-transport system which keeps the paper flat. This is a great advantage since it permits extraordinarily easy front loading of paper onto the tractors and also enables you to insert cut sheets, of any thickness even postcards without difficulty.

Furthermore, the paper you are printing on does not get bent at all during the printing process.

Another good feature is apparent in the way in which the controls have been placed fully visible outside the case of the machine. You do not have to grope down into the bowels of the Riteman looking for the lever to vary the force of impact instead the lever which does this is fully visible and sensibly labelled.

Similarly the paper guides are marked making it easy to set up normal listing paper or A4 accurately.

Switching between tractor and friction is a similar trivial task making the printer foolproof and a pleasure to use.

The simplest and cleverest innovation is the sturdy foldaway wire stand which lifts the printer just a few inches off the table top, thus making room for a decent sized pile of paper.

You have only to trouble about the destination of the output. If your table extends backwards further than the back of the printer, you can allow the paper to build up there. Users who prefer to have the whole box of 1,000 or 2,000 sheets on the floor will find that when the stand is folded away, there is still clearance for the paper to pass beneath the printer. C.Itoh seem to have thought of everything!

The machine runs at 105 characters a second, and prints all 82 Commodore graphics characters in addition to the 96 ASCII characters. The nine-wire head enables full descenders to be printed for good readability.

In use the printer was reasonably quiet and extremely easy to operate. The dip switches to make more fundamental adjustments are easily accessible once the single self-tapping screw holding the flap in place is removed.

The features which are likely to impress most of all are the Bit Image graphics at 480 or 960 dots per line and the complete EPSON compatability. This means that all the fancy Control Codes can be invoked giving double strike, emphasised, double emphasised, italic, compressed and expanded, subscript and superscript characters.

Near Letter Quality print by means of multiple passes is not available, but as you will see from the sample printouts all other likely requirements are catered for.

Indicator LEDs show you when power is on, paper is out and whether the printer is On-Line or not.

The Select button toggles the printer on and off-line and the Form Feed and Linefeed buttons perform their obvious functions.

Ribbon changing is a doddle because the ribbon is in a small neat cartridge and the printhead is changed after 50 million characters, by simply clipping it on and off.

I found the printer to be the simplest I have come across and free from vices. Highly recommended and very good value for money.

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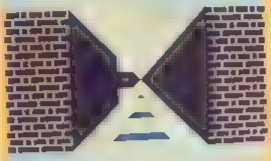


C16/Plus 4 Joystick optional

This game, originally on the 64 has now been converted to the 16. In effect the game is 3D Pac-man and you are actually standing in the maze. The scenario is as before. You must collect all the blue dots on the floor of the maze whilst avoiding the attentions of the gloopers.

These brown creatures patrol the maze and will munch you given half a chance. There are a number of red dots which empower you for a limited time to munch the gloopers. During this period, the gloopers are coloured yellow rather than the usual brown. Clear all the dots and you move onto another screen.

The screen shows a perspective view of the maze walls and side passages. A combination of brick patterns and coloured shading helps the effect. The gloopers are quite simple in design but grow nicely in size as you approach them. In all a surprisingly neat bit of graphics.

You can examine your immediate surroundings on a small map which appears at the top of the screen. This shows the position of dots and gloopers. If a glooper starts to approach you, a warning sound is given. The keyboard or joystick is used to move about the maze. You can move at quite a speed but this isn't always advisable since you can easily turn a corner straight into the arms of a glooper.

In this world of more sophisticated software, it's nice to play a simple but addictive game. I found *Pac-man* rather tiresome since the whole action is visible. In this game, you have no idea where the gloopers are. This engenders a surprising amount of excitement. I found this game great fun to play and quite addictive. The graphics are simple but most effective. At the price, quite good value for money.

M.W

SKYFOX

Ariolasoft £9.95

8 | 9 | 9 | 9

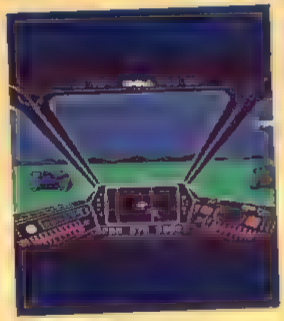
C64

As its title Sky Fox might suggest it is about a jet fighter but it's not one of the flight simulators that have become popular lately - more of an air combat simulator. Thus the pilot doesn't have to concern himself with all the intricacies of take off and landing but can concentrate on the important business of zapping baddies.

This brings us onto the game itself. The story goes that the baddies have invaded, either from another country or another planet, and are about the usual invader - like things such as killing and destroying. Your job is, of course to repel the invaders and save the world/country. In order to achieve this you are equipped with the Sky Fox fighter plane, a weapon capable of standing still in the air or zapping along at speeds of 3000mph! The Sky Fox boasts a full complement of baddie blasters ranging from general purpose laser guns to the air to air heat-seeking missiles.

The screen displays a cockpit view that has three large windows and a radar display which shows either an all round proximity scan or a sort of weaponry screen complete with gun sights. Also available is a direct link to the main battle computer at your base. When activated this swings out on an expanding window to cover the whole display. This computer link supplies information about the progress of the war with the status of various installations being displayed so that you can judge where you are most urgently required.

Also in the data banks is a battle plan displaying the position and number of your foes as well as the locations of your base and the other establishments. This plan may be used to navigate but



using the auto pilot is much more fun as it will either take you to a specific location or it will find the nearest zappable baddie and zoom there at 3000mph.

Whilst being great fun and very convenient, this auto pilot knows nothing of air combat and thus usually engages you with the enemy from the worst possible position. Combat takes two forms. First is the ground force consisting of groups of five tanks. These appear on the display as tiny little blobs on the horizon. At this stage the blobs may be disposed of with the lasers very easily. This would be a shame however because the blobs grow into very detailed battle tanks that shoot at you as you approach and to miss this would spoil the fun. So my advice on the tanks would be destroy all but one, fly over that admiring the excellent graphics and then turn round and blow it to hell.

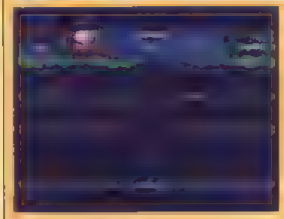
The other form of combat is in the air as you climb from ground level you pass into the cloud layer and the screen goes blank. At this point the disk is being accessed but I think the cloud idea is a nice cover for this. Once through you are presented with a view of clouds and are in the domain of the enemy jet fighters. These usually don't appear at all because the auto pilot lands you in the fight with the nasties behind you. If you do manage to get one in front of you don't forget to be amazed by the smooth animation of such a large and detailed shape before you target the heat seeker and despatch it to the same fate that the tanks suffered. This as ide. I should state that the air combat is not easy at all and took me many goes to get the hang of it.

The biggest and baddest of all are the mother ships. These are like large floating cities in the sky. The mother ships send out all the other baddies so a good plan is to take on the mother ships first to prevent them sending out replacements for the tanks and jets that you destroy. As big as they are they can be taken out by laser work but a lot of careful flying is required to get past the internal defences and they need to be hit a number of times due to their armour. Once you have exhausted your supplies of missiles and fuel you can land at your base to stock up. That is if it still exists!

The game has a large range of options such as difficulty levels from Novice to Ace of the Base and practice levels involving only air or only ground combat. Also selectable is the scale of the baddies' attack and the form of your task. These have titles such as cornered The Alamo and, my personal favourite Massive Onslaught.

BEACH-HEAD II

US Gold £9.95



C64 — 1 or 2 joysticks

This sequel to the successful Beach-Head is not just one game, but four games in one, for one or two players.

The evil dictator known as the Dragon has captured some of your men and is holding them hostage in his heavily fortified island home. The task of the allied forces is to storm the island, rescue the prisoners and escape with them by helicopter. You then do battle in single combat with the Dragon himself.

These four screens may be played in any order, with three skill levels for each. You may choose to play the allied troops or the dictator's forces, so many permutations are available.

The attack phase involves landing your troops by parachute from a helicopter, then advancing them individually past two barriers under withering machine gun fire. You will lose many of your men, and will need to sacrifice some for the safety of others. Bonus points are scored for successful grenade attacks on the machine gun position.

To rescue the hostages you use a captured machine gun against a bewildering array of forces all intent on killing them. This is not easy, as the tanks and armoured trucks need to be hit in exactly the right spot to knock them out.

In the escape stage you fly helicopters, loaded with escapees, past a series of obstacles while under constant fire. You can strike back, and you score points for targets destroyed as well as soldiers rescued. The Dragon sets the difficulty level for each of the three sortties, and the highest level is really hard!

Finally, having tracked the Dragon to his lair, you engage him in battle with wooden spears called Poontas, from opposite banks of an underground river. You move, duck and jump, and can control the spears in flight, making them swerve. Four hits wins a round, nine of which must be played in all.

A marvellous game – challenging throughout, with excellent graphics and the best software speech I've heard. It deserves to be a great success.

P R B

PAINTBOX

Audiogenic

C-16 - Joystick optional

For those who like graphics without mathematics, *Paintbox* is a must for Commodore users. I say users as one side of the tape is for the C64 and the other for the C 16.

Loading is fast and efficient and the menu display scrolls smoothly along the bottom of the screen. At any point the menu is instantly accessible by pressing the space-bar. The menu controls a variety of options, including saving to tape or disk and a fast erase.

Now what does the program offer? DRAWING is, of course, a standard feature using joystick or keyboard. To this is added:

Line – Allows a line to be drawn at any angle.

Lines – draws a series of lines starting from where the last one finished.

Rays – gives a series of lines starting from the same point.

Framing – provides a rectangle of any given size at any position on the screen while BOX gives a solid rectangle of any chosen colour. CIRCLE at any place any size and use DISC to give a coloured filled circle.

This sounds pretty much the same as usual, but believe me, the use of rubber-banding technique gives you tremendous scope and versatility.

When we come to PAINTING the full colour range is available for filling enclosed areas while, in DRAWING mode eight options are available from very fine line to very thick pen which are really excellent. Drawing speed may also be controlled.

For the C64 a one there are extra facilities allowing you to copy, SWAP and MOVE two pictures around building one upon the other.

Audiogenic has produced here a very good, fast acting, easily handled tool which can be used to create very intricate drawings, picture drawings, poster drawings etc.

Paintbox compares most favourably with other graphics utilities and, indeed, would be the one of my choice by virtue of its speed, scope, ease of handling and well written manual. Screen colour control is likewise excellent.

A joystick is preferable but keyboard control is fully functional and adequate.

Go to it beginners and advanced artists. Well recommended.

E M

SPEED KING

Digital Integration £9.95

3 | 7 | 7 | 5

C64 — Joystick optional

If you have quick wits, cool hands and an iron nerve, then this is a game you must buy! You can experience the thrill of high-performance motor-cycle racing at any of the world's top 10 circuits from Brands Hatch to Daytona, at speeds of up to 250 miles per hour. And all this from the comfort of your own armchair.

Each of the circuits is faithfully reproduced, with good graphical representation of the scenery, the track and, of course, the bikes. You race against 19 other riders, starting at the back of the grid. If you collide with another bike you crash, but can set off again. Wandering off the roadway slows you down too, and eventually makes you lose control.

Your machine is equipped with six gears, which you can change up and down, and the sound effects accompanying gear-changes are most realistic. Holding down the fire button (or space bar) causes constant acceleration. Releasing it slows you down, but for heavy braking you will need to change down.

Various options are open to you: in addition to the choice of circuit, you may select novice, pro or champion skill levels, and you are given a preview of the chosen track. You may also do as many practice laps as you wish, before setting off under race conditions. The length of the race may be two, four or six laps. The computer records the total time for the race, and your fastest lap time.

Was impressed with everything about this game. It is very well programmed, fast and exciting. There is plenty of scope for improving your skill by practising, and plenty of variety. It sets a standard for motor-cycling games which will be difficult to beat. So put on your crash-helmet and get started. P.R.B.

RACING DESTRUCTION SET

Ariolasoft £14.95

9 | 8 | 7 | 9

C64

Have you ever had the urge to get in a powerful car and race round a track as quickly as possible? Destruction Set will allow you to indulge all your fantasies and more.

The game consists of two race cars on the same track. Each car's progress is displayed on a separate window on the screen so if one driver gets ahead of his opponent he doesn't disappear off the screen. The cars are rather like slot cars as they will turn corners on their own and the only control required is to change slots and accelerate.

So what is the Construction in the title for? Well this is because RDS allows the user to either choose one of about 20 pre-formed race tracks or even to make one up himself. This allows a sorts of differing terrains and thus the game can change from a Formula One at Silverstone to a dirt track rally on the moon.

To enable the cars to race on the different surfaces the user can also control the design and specification of his car. This allows such things as a Corvet Stingray with an 8.2 litre engine right down to a 250cc Bike.

Care has to be taken when choosing a vehicle as it is very easy to construct a car that is too heavy to get up the steep hills or not powerful enough to get off the line. It is great fun however to pit two entirely different cars against each other on a variable track and see one catch up on the straights due to its power but then fall behind on the hills due to its weight.

What about the destruction bit, I hear you ask? Well this is great fun as well because the game offers options to carry oil, for throwing in the path of your opponent and land mines to blow him up! The problem with both the oil and the mines is that they stay where they are and stay nasty as well so if you drop a land mine in a place where your opponent can't miss it he will blow up but on the next lap if you can't get past it, so will you.

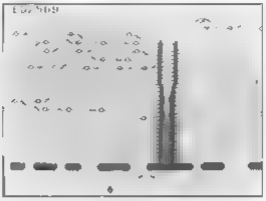
Although the game does a lot of very slow disk accessing I think that it's excellent and I recommend it.

J.G.D.

KAKTUS

Supersoft £4.95 * * * *

2 7 5 7



C16/Plus 4 — joystick optional

This is another C64 conversion from Supersoft. From memory I don't think have been many alterations from the original.

The plot is somewhat unusual in that you must protect a cactus from the unfriendly attentions of a swarm of wasps and hornets. Your efforts are hindered by interfering moles and vultures. In effect this is a shoot-em-up game similar in flavour to centipede but with its own attraction.

On screen you get a side view of the cactus and the ground level. You may move above or below the ground via holes in the ground. The swarm of wasps and hornets approach from above and fly from side to side slowly moving downwards. You must prevent them from reaching the base of the cactus where they can do the most damage.

Unfortunately it isn't a simple matter of shooting the wasps. Moles move from side to side trying to fill in the holes in the ground and cut off your means of access. You, of course, can shoot them. After screen one, vultures fly across dropping eggs. These bounce about and will destroy you on contact.

Graphically, the game is simple with limited use of the C16's colour abilities. The animation of the wasps is quite good but overall the nasties don't really look like the creatures they are supposed to be. Sound is limited to zapping noises although a nice version of Lincolnshire Poacher starts the game.

Whilst this game doesn't break new ground in sophistication it presents a real challenge. The first screen is deceptively easy but our friends the vultures make life pretty tricky later. They seem to aim their eggs accurately and the bouncing bomb behaviour of the eggs is tricky to judge.

Overall not a bad game especially bearing in mind the lack of material for the C16. The rather primitive graphics do the game no favours but it does offer a good old fashioned zapping session.

M W C

WORD PERFECT

Supersoft £19.95 disk * * * *

1 - - 9

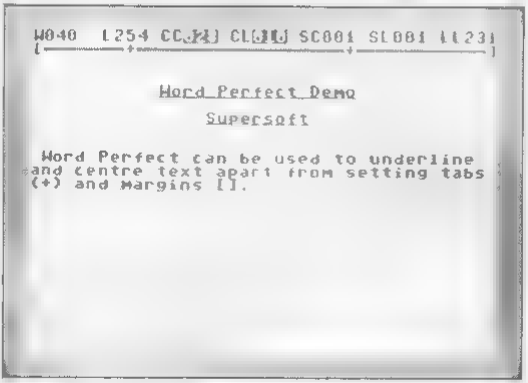
C64

I dare say that a good many owners of the 64 have considered the benefits to be derived from using a word processor but have been deterred by the high price of most of the programs currently available.

Even if you don't own a printer, a word processor can still be extremely useful. How many of you, for instance, can sit down to write a letter and get it right first time without having to rearrange paragraphs, correct spelling or syntax errors, or even re-write the entire thing, perhaps several times? With the aid of a word processor and a little typing practice the whole task becomes very much easier. Using the screen as a sort of electronic note pad, you can organise your thoughts and correct any errors, all, without committing anything to paper.

However, whilst appreciating the above, many people will be unable to justify the expense of a program which although very useful is somewhat limited in its application in the home. *Word Perfect* from Supersoft has recently been released and seems to be a medium-cost such a market. The program is available in both disk and tape format, the disk version being the one reviewed here.

Word Perfect is a scaled down word processor and as such it is suited to any of the uses to which you would put a typewriter, but with most of the advantages of word processing. The program loaded quickly and reliably and resides in the protected RAM above Basic starting at 49152. Most of the important features of a word processor are there, although some of them such as block move and copy are implemented in a somewhat crude fashion. You may search for a specific word or phrase, centre, underline, set tabs and merge previously saved text into the current work. You have the option of saving your finished document to tape or disk.



Although some of the more usual commands are missing, right justify and search with replace for instance, I don't feel that their absence will cause too much inconvenience.

The program allows the use of a wide range of printers although, as with a software that uses a printer, it would be prudent to check that your particular set up works before buying.

Word Perfect comes complete with a well written 16 page booklet that should enable even the novice to quickly get to grips with the program. While perhaps not suited to serious office work, I feel it has a lot to offer the home user. This review was written with the aid of *Word Perfect* and I shall continue to use it in the future.

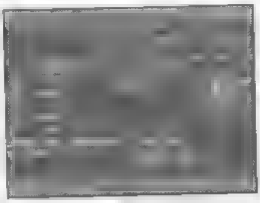
My copy of the manual has an error on page eight. To reformat a paragraph you should press DELETE in CONTROL Mode not R as stated.

D J T

MAIL ORDER MONSTERS

Ariolasoft £14.95 * * * *

10 9 6 £ 8



C64 + joystick

Although the title is different, this is one of the excellent Electronic Arts Construction series.

The game starts by telling you to select a Morph i.e. a basic body type. This varies from the Human Homin to wasps and strange lion like creatures.

Next, weapons must be selected to arm your particular beast. These range from laser rifles and grenades for the humans to noxious spit from the worms and of course deadly claws from the lions.

Then the creatures travel to the teleport chamber where they are left whilst the controllers decide what type of combat is to be engaged. One owner will decide the terrain, and this should be chosen to give your creature the maximum advantage and your opponents the least. So if an owner has an amphibious creature he could choose a terrain with lots of water thus confining his opponent to the land.

The other owner must try to nullify the disadvantages of the terrain by selecting the type of combat. The first type is the simple destruction combat where each player will fight to the death with the creatures found in the arena and the opponent.

The second requires flags to be collected in order. Each flag is defended by an arena creature.

The third type is called the horde. This is when both creatures must work together to defeat an invading horde that comes from the top of the screen and is attempting to reach the bottom. The one who kills most hordings wins.

As I mentioned, the arena contains 'Urban Defenders'. In a one player game all these creatures are played by the computer but in a two player game the creature is played by your opponent. So if a creature runs into an urban defender, the screen clears to a combat screen and the two players battle to the death. This is done by selecting weapons and blasting the enemy. This requires a great deal of dexterity and practice is recommended. If the player is victorious in his attack on the urban defender then the screen changes back to the large map and the game goes on.

Graphics on this game aren't stunning but none of the construction series are. The game is a different matter as it is excellent and I found it extremely addictive. **D.G.D.**

THE GREAT AMERICAN CROSS COUNTRY ROAD RACE

Activision £9.99 * * *

4 7 7 £ 7

At first glance the Great American Cross Country Road Race - T G A C C R R from now on, coz it takes too long to write - is like Audiogenic's Talladega but after closer scrutiny I found some pleasing additions.

After you've chosen your route which is at first a touch confusing (it reminds me of trying to fathom the intricacies of a British Rail time table) - you are shown the map which roughly shows your route between cities and the weather conditions you are likely to encounter. You can scream across the great American countryside/desert/snow plains/etc etc from one sprawling downtown conurbat on like San Francisco to another like Washington experiencing sun and snow.

To practice I chose the US Tour race which, as the name suggests, allows you to belt right round the continent.

After the preliminaries you're faced with the old hat track, down which you must guide your low strung speed machine.

You have a certain amount of time to get from one check point to the next and you're expected to change gear using the joystick while keeping an eye on your fuel. If you allow your RPM to stay in the 'red-line' too long your engine blows up but it doesn't take too much skill to avoid this catastrophe.

Fuel consumption is, I found, another story. This particular hazard really wound me up. When you run out of gas you have to "push" your car to the next station. You do this by continually pressing the fire button. I actually broke my joystick doing this. I believe that this would not have been necessary if the gas stations were more clearly defined, because if you only just miss one you've got to go to the next one which is 100 miles down the road. Infuriating.

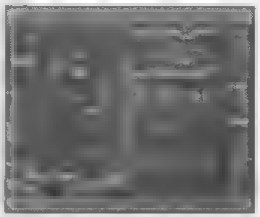
The clever touches in this arcade game are what make it different. As you travel the road conditions change along with the scenery and it gets dark - liked that. If you go too fast you attract the attention of the fuzz and they pull you over.

Altogether this is just another road-race game and, although clever in places with good scrolling graphics, I feel that once you've seen one there isn't a lot of difference in the rest - but this is certainly one of the best. **D.F.**

PINBALL CONSTRUCTION SET

Ariolasoft £14.95 * * *

7 7 8 £6



C64 + Joystick

The Idea behind the construction series of games is that people could adapt a game which they liked to take on many different forms and levels of difficulty so as to improve their enjoyment. This isn't the case with Pinball C S.

The game is a representation of a pinball board which can be set up to the user's requirements. All manner of bouncers, flippers and fancy bits may be put together on the board in an attempt to find an interesting game. This is where the construction bit fails down as most fun is to be had in the construction of weird and wonderful boards. Playing these boards soon becomes very boring indeed! As at the fun in real pinball is in the flashing lights and ping, ping ping noise.

Anyway, back to the game. As I mentioned, the game allows use of bumpers and flippers. It also has many advanced features such as a ball hopper which collects balls until it's full at which point it releases them all putting four balls in play at once. Another interesting feature is the AND gate that allows special scores to be awarded for good play.

All in all I was disappointed by this nice idea but a boring game. **J.G.D**

THE RATS

Hodder and Stoughton £7.95 * *

9 3 5 £4

C64

As reported in the October issue of Your Commodore, Hodder and Stoughton Software has released the computer version of that now age old horror story The Rats by James Herbert.

When I got my grubby little paws on, the game I could hardly wait to get it in the C2N and have a look – you see dear reader I did read the book and seen the film already and thought they were both terrific – so maybe I expected too much.

In the game you take the roles of various characters in the original story except the rats, of course. You can for instance, be anyone from the controller of defence to a cobbler which altogether, adds to the general confusion and this, in my opinion, is the only atmosphere generated by this attempt to mix all the aspects of micro-gamesmanship in one package. I think it's a shame that the game didn't live up to my expectations especially after the stunning graphics that are displayed after the animation sequence.

The game is staged in central London where the rats are swiftly taking over and it's your task, with the help of the defence forces and various wizardry from the research and development people, to contain the hideous menace with in London whilst keeping the three main characters alive and not at the expense of every last man jack in your defence forces. To fail in any part results in defeat and some supposedly horrifying graphics.

To effect the destruction of the rats you are given various tools and professional forces to help you and you must put into action Foskins (one of your main characters) strategic battle to do this. This is done by moving a cursor again in to pick the words (your choice of which is maddeningly limited) to build the command. Needless to say I was shredded very quickly and often.

It is a good idea, but with the lack of atmosphere and the limitations imposed by the program I found it hard work and it lost my interest very quickly. Like said I did read the book, seen the film and now I've played the game. I think I would have prefered the pie.

D F

KAYAK

Creative Sparks — Sparklers £2.50 *

2 5 3 £3

C64 — joystick

If you find it exciting to have a cold bath on a foggy Sunday afternoon in November, while Chopin's funeral march plays in the background, then this is the game for you! According to the rather ungrammatical cassette insert, your mouth will be dry and your arms shaking with excitement – yes, all of it yes!

The idea of the game is that you paddle a canoe in the World White Water Slalom Championship. This involves two forays along a stretch of wind ing river, with 25 gates to negotiate, remembering to keep the white pole to your left at each. The control you have over your craft is minimal. Attempting to turn usually ends with you ramming the bank, at which point the program is as likely as not to seize up altogether.

The "superb scrolling 3D" graphics mentioned on the packaging are in fact crude and jerky, with the prow of your boat bobbing up and down in the foreground and slalom gates appearing as if by magic, just in front of you. Making headway against the current is practically impossible, and response to the joystick is very slow indeed. The game proceeds at the pace of a snail with corns!

The only sound-effect, apart from a discordant fanfare at the start, is like nothing so much as brushing a pair of shoes, or perhaps a veteran washing-machine. There is a high score table, of a sort, but even that is mud-coloured. The inlay asks "Will you have the stamina and strength to last the whole course?" – I very much doubt it!

I seem rather unkind, but as we deserved. This is the poorest game have seen for a long time, and the best thing to do with it is cover the tabs on the cassette and record something else over the top. Unless, perhaps, you suffer from insomnia?

P R B

This month Margaret Webb explains how adventure games can be used as a valuable educational aid.

THIS MONTH I INTEND TO DISCUSS THE value of adventures as educational aids. In contrast to the monthly adventure columnist, with whom I don't want to compete, I will be advising the uninitiated, not preaching to the converted.

Many parents feel that programs other than educational software cannot be of any benefit to their children. This is simply untrue since we learn something no matter what task we're performing. The noisiest shoot the alien game may seem pointless but it does teach eye-hand co-ordination and helps improve reaction times. Adventures are a more subtle means of combining enjoyment with learning.

Before diving into the material, it would be best to try to describe what is meant by an adventure. Initially adventures were simply word-games programmed on main frame computers. With the development of home micros, the games have changed form. First the text acquired graphics, then animation and interaction was developed and finally arcade/real time features appeared. All offer similar benefits albeit in differing proportions.

Most adventures involve placing the player, or his alter-ego, in an artificial scenario. By use of various forms of instruction, the player endeavours to solve certain problems or achieve certain goals. The scenario can basically be anywhere and can be mapped on a piece of paper. A building, for example, can be drawn in terms of rooms and passages.

The first task usually attempted in an adventure is to map, by exploration, the area where you find yourself – just as you would in real life. This means that you may need to know such concepts as the points of the compass and left, right etc. The scenario is normally too complex to remember, forcing you to draw some form of map. Again this is a tricky task involving the manipulation of spatial concepts.

The mapping operations and the actual solution of the game need a rather special form of skill – the ability to think logically and apply lateral reasoning. A simple example is how to get past a fire breathing serpent which blocks your way when you're carrying a sword, a bucket of water and wearing running shoes. You could: Kill the dragon; put his fire out with the water; out run him; or use your map and find another route.

The problem is to find the correct solution and the means to achieve it using thought, trial and error and patience. All useful skills for real life!

Most of the best adventures use text to convey information and accept instructions. These processes will help improve reading, increase vocabulary, spelling, comprehension and creative writing but not to an extreme degree.

That's the boring bit out of the way, let us look at what's available. It might be easiest to deal with them in rough age groups (this list is not exhaustive, simply a guide).

Under-tens

The Magic Sword (Database Publications) is a fairy tale book plus a simple adventure. The adventure uses simple text with graphics and the instructions are mostly key commands. You must find the prince (who has been turned into a frog) so that he can save Princess Poppy from the wicked witch.

Danger Mouse in the Black Forest Chateau (Creative Sparks) is a graphics/text adventure with menu driven command structure. There are lots of silly puns and great fun, pretty too. Help Danger Mouse save the world from the Pi-beam.

Early Secondary (and Smart Little Uns)

This age group seems to prefer arcade type action and there are a range of tough graphics-only games to choose from. All of these require problem solving and lateral thought. Some worthy titles include: *Impossible Mission* (Epyx), an arcade style game requiring both physical and mental agility; *Staff of Karnath* (Ultimate), a magic type game involving exploration of a tomb and the fighting of foes with magic; *Elidon* (Orpheus) in which you guide the fairy on her search for magic potions and plants; *Dungeons of Ba* (Quicksilva), search the dungeons, find the treasure, kill the nasties; *Shadowfire* (Beyond) uses advanced graphics techniques. You control an inter-galactic 'A's team' trying to rescue an ambassador; *Tir Na Nog* (Gargoyle), a Celtic legend in which you help the hero find the Seal of Calum; *Exodus: Ultima III* (US Gold), Dragons and Dungeons style, you lead your band of heroes on a quest.

Teens to Old-Uns

The most challenging games tend to be text or text/graphics adventures. Whilst graphics help brighten up a game, you should be aware that the pictures only rarely give clues to the solution of the game. The list of such games is endless. There are some excellent software houses who are almost guaranteed to produce excellent games.

Those of note are:

Infocom – disk only, heavy use of detailed and absorbing text – a sense of humour vital. Those worth looking at are the *Zork Trilogy* (wizards and dungeons), *Starcross* and *Suspended* (science fiction) and *Hitch Hiker's Guide to the Galaxy* (humorous).

Level Nine – early games text only, later games use graphics. Complex games with many locations – text compression ensures detailed descriptions.

Adventure International – not the most complex games but have a very high content of puzzles. Great variety covering many types of scenario. Later games include *Gremlins* and *Incredible Hulk*.

Individual games of note are:

The Hobbit (Melbourne House) – on the book, quite tough.

Twin Kingdom Valley (Bug Byte) – superb graphics, complex and quite tough.

Fourth Protocol (Hutchinson) – amazing graphics, needs deep thought and a devious mind.

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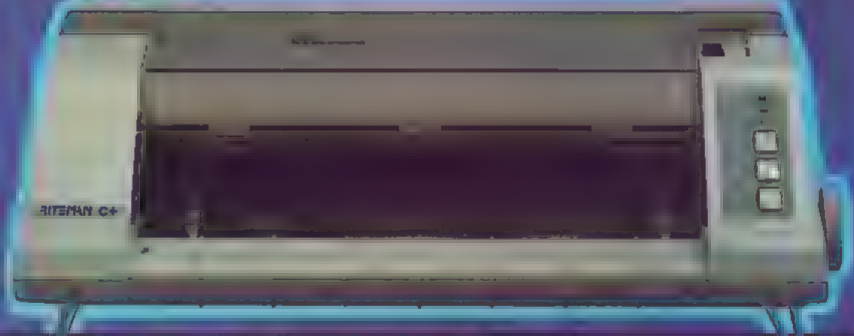

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Build a better BASIC

Nick Hampshire adds more commands to your ever-increasing Basic.

IN LAST MONTH'S ISSUE I gave all the initialisation and wedge routines needed to add extra commands to the Basic of a C64 computer. Also included in that article was a single command CTL. In this second article I am giving four new commands, APPEND, CHANGE, DUMP and FIND. These are very useful 'toolkit' type commands for editing a program and are consequently all used in direct mode.

These four new commands all require the wedge and initialisation code – given last month – to be present in memory at the correct locations and that their command names and entry points are stored in the correct tables. It should also be noted that all these commands use common routines within each other and should therefore always be used as a set. To ensure that you have these correctly positioned the Basic loader at the end of this article is a repeat of last month's with the three new commands added

CHANGE

Abbreviated entry: C(shift)H
Affected Basic abbreviations: CHR$ – CH (shift)R
Token: Hex $EE, $06 Decimal 238,6
Modes: Direct and program
Recommended mode: Direct only
Purpose: To change all occurrences of a string or command to something else

```
CHANGE
1000 CHANGE JSR RESVAR ;RESET LINE LINKS
1010  JSR FIND14 ;GET CURRENT CHAR
1020  STA $59 ;STORE IN FLAG
1030  LDX #$00
1040  JSR FIND03 ;GET SEARCH STRING
1050  LDX #$00
1060  JSR CHAN07 ;GET STRING TO CHANGE
1070  STX $FC ;STORE LENGTH OF CHANGE STRING
1080  JSR FIND05 ;SETUP POINTERS
1090  SEI
1100  LDA $0300
1110  STA FINDER
1120  LDA $0301
1130  STA FINDER+1
1140  LDA #<FIND11 ;SPEED UP TO RTS
1150  STA $0300
1160  LDA #>FIND11
1170  STA $0301
1180  CLI
1190  JSR FIND06 ;FIND STRING
1200 CHAN01 JMP CHAN03 ;CHANGE
1210 CHAN02 JSR FIND12 ;LIST LINE
1220  JSR FIND07 ;FIND STRING
1230  JMP CHAN01 ;AND REPEAT
1240 ;
1250 CHAN03 LDA $FC ;LENGTH OF CHANGE STRING
1260  SEC
1270  SBC $22 ;- LENGTH OF FIND
1280  BEQ CHAN04 ;THEY ARE EQUAL
1290  JMP CHAN10 ;ELSE CHANGE SIZE
1300 CHAN04 LDY $23 ;INDEX TO LINE
1310  LDX #$40 ;INDEX TO CHANGE STRING
1320  LDA $01
1330  AND #$FE ;OUT BASIC ROM
1340  STA $01
1350 CHAN05 LDA $BF40,X ;GET CHANGE CHAR
1360  BEQ CHAN06 ;END OF STRING
1370  STA ($57),Y ;REPLACE CHAR
1380  INX ;NEXT CHAR
1390  INY ;NEXT BYTE
1400  JMP CHAN05 ;AND AGAIN
1410 CHAN06 LDA $01
1420  ORA #$01 ;IN BASIC ROM
1430  STA $01
1440  DEY
1450  STY $23 ;STORE LINE INDEX
1460  JMP CHAN02 ;DO NEXT FIND
1470 ;
1480 CHAN07 JSR FIND13 ;GET NEXT CHAR
1490  CMP $59 ;IS IT THE FLAG?
1500  BEQ CHAN08 ;YES, GET STRING
1510  JMP $AF08
1520 CHAN08 JSR FIND13 ;GET NEXT CHAR
1530  BEQ CHAN09 ;END OF LINE
1540  CMP $59 ;END OF STRING?
1550  BEQ CHAN09 ;YES
1560  STA $BF80,X ;STORE CHAR
1570  INX
1580  CPX #$40 ;STRING TOO LONG?
1590  BNE CHAN08 ;NO
1600  LDX #$17 ;STRING TOO LONG
1610  JMP $A437 ;OUTPUT ERROR
1620 CHAN09 LDA #$[illegible] ;STRING TERMINATOR
1630  STA $BF80,X ;STORE IT
1640  RTS
1650 ;
1660 CHAN10 LDY #$0
1670  LDA [illegible],Y ;GET LINE# LO
1680  STA $14 ;STORE IT
1690  INY
1700  LDA [illegible] ;GET LINE# HI
1710  STA [illegible] ;STORE IT
1720  LDX #$[illegible]
1730 CHAN11 INY
1740  CPX [illegible] ;END OF PROGRAM BYTE
1750  BEQ CHAN12 ;YES, INSERT IT
1760  LDA [illegible],Y ;GET PROGRAM BYTE
1770  STA [illegible],Y ;STORE IN BUFFER
1780  INX
1790  CPX #$56 ;BUFFER FULL
1800  BNE CHAN11 ;NOT YET
1810 CHAN12 LDA $0.
1820  AND #$FE ;OUT BASIC ROM
1830  STA $[illegible]
1840  LDY #$[illegible]
1850 CHAN13 LDA $BF[illegible],Y ;GET CHANGE STRING CHAR
1860  BEQ CHAN14 ;END OF STRING
1870  STA [illegible],Y ;STORE IN BUFFER
1880  INX ;NEXT CHAR
1890  INY ;NEXT PROGRAM BYTE
1900  CPX #$57 ;END OF BUFFER
1910  BNE CHAN13 ;NO
1920 CHAN14 LDA $[illegible]
1930  ORA #$01 ;IN BASIC ROM
```

```
1950  STA $21
1960  LDA $2F ;CALCULATE START
1970  CLC ;OF REST OF PROGRAM LINE
1980  ADC $22 ;AFTER INSERTING THE
1990  TAY ;CHANGE STRING
2000  LDA $22
2010  CLC
2020  ADC $FC
2030  STA $22
2040  DEC $2F
2050 CHAN15 LDA ($F),Y ;GET PROGRAM BYTE
2060  STA $3270,Y ;STORE IN BUFFER
2070  INY ;NEXT BYTE
2080  INX ;NEXT CHAR
2090  CMP #$0D ;END OF LINE?
2100  BEQ CHAN16 ;YES
2110  CPX #$5B ;END OF BUFFER?
2120  BNE CHAN15 ;NOT YET
2130  LDA #$00 ;ZERO IF END OF BUFFER
2140  STA $0200,X ;STORE IT
2150  INX
2160 CHAN16 STX CHANLN ;STORE LENGTH OF
2170  TXA ;LINE
2180  CLC
2190  ADC #$04
2200  STA $0B
2210  LDA $0202
2220  STA CHANST
2230  LDA $0203
2240  STA CHANST+1
```

```
1930  LDA # [illegible] ;BASIC ADDR START
1940  STA $ [illegible] ;SET [illegible]
1950  LDA # CHAN.
1960  STA $020
1970  JSR FIND1E ;S[illegible]
1980  [illegible] $ 2 ;GET POINTER
1990  CMP $140* ;[illegible]
2000  [illegible] LDA [illegible]
2010  [illegible] LDA $A0[illegible]
2020  [illegible] JSR FIND[illegible] ;RELOCATE POINTERS ETC
2030  [illegible] $[illegible]
2040  [illegible] $CC
2050  [illegible] $F8
2060  [illegible] $2C
2070  [illegible] BEQ CHANDY ;YES
2080  [illegible] CMP #$ [illegible] ;END OF LINE?
2090  [illegible] BEQ CHA[illegible]
2100  [illegible] ;NO CHAN[illegible] ;DIE WE DO [illegible]
2110  [illegible] CMP #$ [illegible] ;END OF LINE?
2120  [illegible] BEQ CHA[illegible]
2130  [illegible] ;NO CHAN[illegible] ;GET ASC OF NEXT
2140  [illegible] ;## [illegible] Y TO NEXT [illegible]
2150  [illegible] $2[illegible]
2160  [illegible] LDA #[illegible]
2170  [illegible] JMP CHAN[illegible] ;GO NEXT ##THOUT [illegible]
2180  CHANDY JMP [illegible] ;BY [illegible] CHANGE
2190  CHANLN .BS [illegible]
2200  CHANST .WO[illegible]
2210  .END
```

Each line that is changed is listed if there is anything left to list.

Syntax: CHANGE dstr1 ddstr2d – where d is a delimiter character that does not appear in either of the strings (str1 or str2)

Errors: Syntax error – if the format is not as above String too long – if either str1 or str2 are longer than 40 characters.

Use: CHANGE has a number of uses. An example would be

```
CHANGE PRINT PRINT#4
```

To change all occurrences of 'PRINT' to 'PRINT#4,', or

```
CHANGE "PRINT""PRINT#4,"
```

which will change all occurrences of the text 'PRINT' to the text 'PRINT#4,'

Note: Not all delimeter characters will work in all cases, for example.

```
CHANGE /REM///
```

As the character '/' has two values the first is the token for divide and the second is just the ASCII slash character

The same is true of DATA Other characters that will have the same effect are '+' '*' '=' '.'

Routine entry point: $86BB

Routine operation: CHANGE uses most of the FIND routines to find str1 and list the line

CHANGE reads in the delimiter byte and stores it away. The string to be changed is then read in until the second delimiter character is reached and stored The next character is checked to see that it equals the delimiter character and if so the string to change to is read in until the delimiter character is found again or the end of command

The rest of the routine is just a loop finding all occurrences, changing them and listing until the end of the program.

The actual routine that changes the string uses the Basic input buffer and the Basic routines to change a line. The routine copies the line up to str1 into the buffer, the change string (str2) is then copied to the buffer and the remainder of the line is copied over. The pointers are then set so that the next byte to check is the one following str2.

DUMP

```
[illegible] DUMP LDA $2F ;GET START OF VARIABLES
[illegible] STA $[illegible] ; AND STORE IN FRO[illegible]
[illegible] LDA $2D ; LOCATIONS
[illegible] STA $FE
[illegible] ,
1050 DUMP01 SEC ;START OF MAIN [illegible]
[illegible] SBC $2F ;END OF ,AR1AB [illegible]
1070 LDA $60
1080 SBC $30
1090 BCC DUMP02 ;NO
1100 JMP DUMP17 ;YES, DISPLAY ARRAY DIMS
1110 :
1120 DUMP02 JSR DUMP1E ;GET VAR NAME
1130 LDA $25 ;REAL?
1140 BEQ DUMP07 ;YES
1150 CMP #$01 ;FUNCTION?
1160 BEQ DUMP25 ;YES
1170 CMP #$02 ;STRING?
1180 BEQ DUMP04 ;YES
1190 LDA #$25 ;M ST BE INTEGER
1200 JSR $FFD2 ;PRINT %
1210 JSR DUMP15 ;ANY EXTRA SPACES
1220 LDA #$2D
1230 JSR $FFD2 ;PRINT '='
```

```
1240 LDY #$02 ;SET POINTER TO VAL
1250 LDA ($5F),Y ;GET LO
1260 PHA
1270 INY
1280 LDA ($5F),Y ;GET HI
1290 TAY
1300 PLA
1310 JSR $B391 ;FIX-FLOAT
1320 JSR $BDDD ;FLOAT-ASCII
1330 JSR $AB1E ;PRINT IT
1340 JMP DUMP07 ;DO NEXT VAR
1350 ,
1360 ;REAL VARIABLE
1370 :
1380 DUMP07 LDA $2D
1390 JSR $FFD2 ;PRINT SPACE
1400 JSR DUMP15 ;PAD NAME
1410 LDA #$2D
1420 JSR $FFD2 ;PRINT '='
1430 JSR $B185 ;GET ADDRESS OF VAR
1440 LDA $47 ; INTO A AND Y
1450 LDY $48
1460 JSR $BBA2 ;MEM-FAC#1
1470 JSR $BDDD ;FLOAT-ASCII
```

DUMP

Abbreviated entry: D shift O
Affected Basic abbreviations: None
Token: Hex $EE $0C Decimal 238 12
Modes: Direct and program
Recommended mode: Direct
Purpose: To display the values of all simple variations, name functions, and display the dimensions of arrays
Syntax. DUMP
Errors: None
Use: For de-bugging Basic programs, the DUMP command may be used after the program has run to get a list of all variables and the values. As an added bonus not found in any other DUMP command for the Commodore 64, all array dimensions are also given. The DUMP command will also display function names
Routine entry point: $8B02
Routine operation: The DUMP routine sets a pointer to the start of variables and checks for the end of variables. If it does not find any, the variable name is read in and displayed. The variable type is determined and the display is produced according to which type is required. When a simple variables have been processed arrays are handled. The array names are read and displayed in the same way as the simple variables and the number of dimensions read off. The pointer is then set to the end of the dimension entries and reading backwards, the dimensions are read and displayed

FIND

Abbreviated entry: F shift I
Affected Basic abbreviations: None
Token: Hex $EE $0E Decimal 238 14
Modes: Direct and program
Recommended mode: Direct only
Purpose: To find all occurrences of a string or command in a Basic program
Syntax: FIND string – where this the delimiter character as in CHANGE
Errors: Syntax error if the syntax is not as above. String too long if the string is longer than 40 characters
Use: FIND is another useful routine for de-bugging and

```
DUMP
1480  JSR $BDDA ;PRINT NUMBER
1490  JMP DUMP07 ;DO NEXT VAR
1500 :
1510 ;FUNCTION
1520 :
1530 DUMP26 JSR DUMP15 ;PAD NAME
1540  LDA #/FUNCTT ;POINT TO
1550  LDY #>FUNCTT ;'FUNCTION'
1560  JSR $AB1E ;PRINT STRING
1570  JMP DUMP07 ;DO NEXT VAR
1580  FUNCTT .BYT 'F' = FUNCTION'.$00
1590 :
1600 ;STRING VARIABLE
1610 :
1620 DUMP04 LDX #$02 ;LOOP TO PRINT '$= '
1630 DUMP05 LDA DUMTEXT,X
1640  JSR $FFD2
1650  CPX #$[illegible]
1660  BNE DUMP05
1670  BEQ DUMP15 ;PAD FOR NAME
1680 DUMP06 DEY
1690  BEQ DUMP15 ;COMPLETE LOOP
1700  LDY #$[illegible] ;ADDRESS OF STRING
1710  LDA $FF,Y
1720  STA $22
1730  DE
1740  LDA $FF,Y
1750  STA $23
1760  DE
1770  LDA $FF,Y ;LENGTH
1780  JSR $AB04 ;PRINT STRING FROM $22
1790  LDA $22  ;AND LENGTH IN A
1800  JSR $FFD2 ;PRINT IT
1810 :
1820 ;PRINT CARRIAGE RETURN AND DO NEXT
1830 :
1840 DUMP07 LDA #$0D
1850  JSR $FFD2 ;PRINT RETURN
1860 DUMP08 JSR $FFE1 ;STOP KEY?
1870  BNE DUMP10 ;NO
1880 DUMP09 RTS ;EXIT TO 'READY'
1890 DUMP10 CLC ;MOVE TO NEXT VAR
1900  LDA $5F
1910  ADC #$07
1920  STA $5F
1930  LDX $60
1940  BCC DUMP11
1950  INX
1960 DUMP11 STX $60
1970  JMP DUMP01 ;DO NEXT VAR
1980 :
1990 ;GET AND PRINT VAR NAME
2000 :
2010 DUMP12 LDY #$00 ;GET VARIABLE TYPE
2020  STY $2E  ;AND NAME
2030  INY
2040 DUMP13 LDA  $5F),Y ;GET BYTE
2050  ASL A ;TYPE BIT INTO TEMP
2060  ROL $2E
2070  LSR A ;RESTORE NAME BYTE
2080  STA $0045,Y ;STORE NAME BYTE
2090  DEY
2100  BPL DUMP13
2110  LDA $45 ;PRINT NAME
2120  JSR $FFD2
2130  LDA $46 ;2ND BYTE?
2140  BEQ DUMP14 ;NO
2150  JSR $FFD2 ;YES, PRINT IT
2160 DUMP14 RTS ;DONE
2170 :
2180 ;PAD OUT NAME IF ONLY 1 BYTE LONG
2190 :
2200 DUMP15 LDA #46 ;2ND BYTE?
2210  BNE DUMP16 ;YES, DON'T PAD
2220  LDA #$20 ;ELSE PAD WITH SPACE
2230  JSR $FFD2 ;PRINT
2240 DUMP16 RTS ;DONE
2250 :
2260 ;DISPLAY ARRAY NAMES AND DIMENSIONS
2270 :
2280 :
2290 DUMP17 LDA #$0D ;SEPARATE NORMAL
2300  JSR $FFD2 ; VARS FROM ARRAYS WITH
2310  LDA $0F ; A CARRIAGE RETURN
2320  STA $5F ;SET POINTER TO ST
2330  LDA $10 ; SEPA
2340  STA $6
2350 :
2360 DUMP18 LDA $60 ;END OF ARRAYS?
2370  CMP $12
2380  BNE DUMP19 ;NO
2390  LDA $5F
2400  CMP $11
2410  BEQ DUMP09
2420 :
2430 DUMP19 JSR $FFE1 ;STOP KEY?
2440  BEQ DUMP09 ;YES,EXIT
2450  JSR DUMP12 ;GET AND PRINT NAME
2460  LDA $2E ;WHICH TYPE?
2470  BEQ DUMP21 ;REAL
2480  CMP #$02 ;STRING?
2490  BNE DUMP20 ;NO, ARRAY IS INTEGER
2500  LDA #$24 ;CHAR '$'
2510  .BYT $2C ;SKIP 2 BYTES
2520 DUMP20 LDA #$25 ;CHAR '%'
2530  .BYT $2C ;SKIP 2 BYTES
2540 DUMP21 LDA #$20 ;CHAR ' '
2550  JSR $FFD2 ;PRINT IT
2560  JSR DUMP15
2570  LDA #$20
2580  JSR $FFD2 ;ONE EXTRA SPACE
2590  LDA #$28 ;CHAR '('
2600  JSR $FFD2 ;PRINT IT
2610  LDA $5F
```

DUMP

```
[illegible]
```

checking Basic programs, for example

FIND PRINT

which will find and list all lines containing the command PRINT. If PRINT occurs more than once on a line, the line will be listed each time it is found with the exception of the last lines where the line will be listed only once.

Routine entry point: $8D93

Routine operation: The string to be found is read in within quotes, including spaces and colons and stored away. The rest of the program is a loop that searches the program until the string has been found, lists the line, and starts searching from the next character.

The error message vector is stored away and replaced with a jump to an 'RTS' so that LIST will return to the routine.

APPEND

Abbreviated entry: A(shift)P

Affected Basic abbreviations NONE

Token: Hex $EE,$03 Decimal 238,3

Modes: Direct and program

Recommended mode: Direct

Purpose: To load a program into memory so that it appears 'on top' of the current program. This routine will work with both disk and cassette and the variable pointers when loaded are set to the end of the combined program. When this routine is used, you should check that the line numbers of the APPENDed program are larger than the line numbers of the program in memory.

Syntax: APPEND [filename[,d[,s]]] – where d is the device number and s is the secondary address

Errors: The same errors will be encountered as in the Basic command LOAD

Use: This routine would be used mostly to add Basic library routines onto the end of your programs. It would be used rather than MERGE because APPEND is much faster.

Routine entry point: $84D8

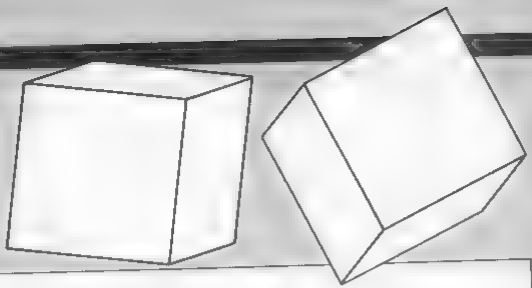
Routine operation: The APPEND routine uses LOAD's parameter parsing routine to get the filename etc. then sets the secondary address so that it loads at the end of the Basic program in memory. The load

FIND

```
.000 FIND JSR FIND14 ;GET CHARACTER
.010 STA $59 ;STORE IN FLAG
.020 LDX #$00
.030 JSR FIND03 ;EST SEARCH STRING
.040 JSR FIND05 ;SET PTR POINTERS
.050 SE
.060 LDA $1000
.070 STA FINDER
.080 LDA $[illegible]
.090 STA FINDER+1
     LDA # FIND1 ERROR LINK TO RTS
.100 STA $0[illegible]
.110 LDA # FIND1
[illegible]
.1150 JSR FIND06 ;FIND STRING
.1160 FIND01 JSR FIND12 ;LIST LINE
.1170 JSR FIND07 ;FIND STRING
.1180 JMP FIND01 ;AND REPEAT
.1190 ;
.1200 FIND02 JMP $AF08 ;SEND SYNTAX ERROR
.1210 ;
.1220 FIND03 JSR FIND17 ;GET A CHARACTER
.1230 BEQ FIND02 ;END OF LINE
.1240 CMP $59 ;END OF STRING?
.1250 BEQ FIND04 ;YES, COMPLETE
```

routine is then called and the program re-chained and variable pointers set.

These extended Basic routines are all taken from the book *Advanced Commodore 64 Basic Revealed* by Nick Hampshire, published by Collins.



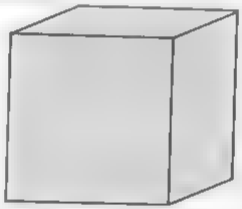
FIND

```
STA $BF40,X ;STORE IN SEARCH STRING
INX
CPX #$40 ;STRING TOO LONG?
BNE FIND03 ;NO
LDX #$17 ;STRING TOO LONG
JMP $A437 ;OUTPUT ERROR
FIND04 LDA #$00 ;TERMINATOR TO STRING
STA $BF40,X ;STORE IT
STX $22 ;STORE STRING LENGTH
RTS ;EXIT
;
FIND05 LDA $28 ;GET START OF PROGRAM
CLC
ADC #$02 ;PLUS 2
STA $57
LDA $2C ;GET START OF PROG MSB
ADC #$00
STA $58 ;STORE IT
RTS
;
FIND06 LDX #$00 ;INDEX TO STRING
LDY #$02 ;INDEX TO LINE
STY $23
FIND07 LDA $01
AND #$FE ;OUT BASIC ROM
STA $01
LDA ($57),Y ;GET BYTE
BEQ FIND09 ;END OF LINE
CMP $BF40,X ;SAME AS STRING?
BNE
PHP
LDA $01
ORA #$01 ;IN BASIC ROM
STA $01
PLP
BNE FIND08 ;NOT MATCHED
INY ;NEXT BYTE
INX ;NEXT CHAR
CPX $22 ;STRING MATCHED?
BNE FIND07 ;NO
RTS ;YES
FIND08 INC $22 ;START AT NEXT BYTE
LDY $23
LDX #$00 ;AND START OF STRING
LDA ($57),Y ;GET BYTE
BEQ FIND10 ;END OF LINE
JMP FIND07 ;TRY AGAIN
FIND09 LDA $01
ORA #$01 ;IN BASIC ROM
STA $01
LDA $57
SEC
SBC #$02 ;LINE POINTER -2
STA $57
LDA $58
SBC #$01
STA $58
LDY #$00
LDA ($57),Y ;GET LINK LO
STA $59 ;STORE IT
INY
LDA ($57),Y ;GET LINK HI
STA $59 ;STORE TO POINTER HI
ORA $59 ;END OF PROGRAM?
BEQ FIND10 ;YES
LDA $59 ;GET LINE POINTER LO
CLC
ADC #$02 ;ADD 2
STA $57 ;STORE IT
LDA $58 ;GET HI BYTE
ADC #$00
STA $58
JMP FIND06 ;DO NEXT LINE
FIND10 SEI
LDA FINDER ;RESET ERROR LINK
STA $0300
LDA FINDER+1
STA $0301
JMP $A474 ;EXIT
;
FIND11 RTS ;ERROR LINE
;
FIND12 LDY #$01
JSR FIND15 ;SAVE POINTERS
LDA #$01 ;CLOSE FILE
JSR $FFC3 ;PRINT IT
LDA $57 ;GET LINE# LO
STA $14 ;STORE IT
INY
LDA ($57),Y ;GET LINE# HI
STA $15 ;STORE IT
JSR $A613 ;FIND LINE ADDRESS
BCS $A8C8 ; IGT LINE
JSR FIND16 ;RESTORE POINTERS
INC $17 ;NEXT CHAR IN LINE
LDY $22
LDX #$00 ;START OF STRING
RTS
;
FIND13 INC $22 ;NEXT BYTE
BNE FIND14
INC $23
FIND14 LDY #$00
LDA ($A1),Y ;GET INPUT BYTE
RTS
;
FIND15 LDA $22 ;STORE STRING LENGTH
STA FIND17
LDA $27 ;STORE LINE INDEX
STA FIND17+1
LDA $57 ;STORE LINE POINTER LO
STA FIND17+2
LDA $58 ;HI
STA FIND17+3
LDA $FC ;CHANGE PARAMETER
STA FIND17+4
RTS
;
FIND16 LDA FIND17 ;GET STRING LENGTH
STA $22
LDA FIND17+1 ;GET LINE INDEX
STA $27
LDA FIND17+2 ;GET LINE POINTER LO
STA $57
LDA FIND17+3 ;GET LINE POINTER HI
STA $58
LDA FIND17+4 ;GET CHANGE PARAMETER
STA $FC
RTS
FIND17 .BYT $00,$00,$00,$00,$00
FINDER .WDR 0
.END
```

APPEND

```
1000 APPEND LDA $$00
.010  STA $0A
1020  JSR $E1D4 ; GET FILE PARAMETERS
1030  LDA $$00
1040  STA $B9 ;SET SA FOR ALT LOAD
1050  LDA $2D
1060  SEC
.070  SBC $$02 ; SET LOAD ADDRESS
1080  TAX : DIRECTLY AFTER RESIDENT
1090  LDA $2D+1 ; PROGRAM.
1100  SBC $$00
1110  TAY
1120  LDA $0A
1130  JSR $FFD5 ; LOAD
1140 ;
1150 RESVAR JSR $A523 ;RE-CHAIN LINES
1160  LDA $2D
.170  LDY $2D+1 ; RESET VARIABLE
1180  SEC : POINTERS TO END OF
1190  SBC $$02 : NEW PROGRAM
1200  STA $57
1210  TYA
1220  SBC $$00
1230  STA $57+1
1240 RESV01 LDY #$00 : FIND END OF PROGRAM
1250  LDA ($57),Y ; AND SET VARIABLE
1260  BNE RESV01 : POINTERS
1270  INY
1280  LDA ,$57),Y
1290  BNE RESV02
1300  LDA $57
1310  CLC
1320  ADC $$02
1330  STA $2D
1340  STA $2F
1350  STA $31
1360  LDA $57+1
1370  ADC $$00
1380  STA $2D+1
.390  STA $2F+1
.400  STA $31+1
1410  RTS
1420 RESV02 LDY $$00 ; NOT YET END OF
1430  LDA ($57),Y ; PROGRAM. GET
1440  STA $59 ; ADDRESS OF NEXT
1450  INY : LINE.
1460  LDA ($57),Y
1470  STA $57+1
1480  LDA $59
1490  STA $57
1500  JMP RESV01
1510 .END
```

BASIC LOADER



```
.00 REM  ******************************
.0 REM *T  .I LOADER FOR THE BASIC   *
.. REM *E. C' ION PACKAGE            *
. C. REM *.   LES WEIDE" AND THE     *
.0 REM * C'MMANDS                    *
.. REM *ADRESS, CHANGE, CTL, DUMP AND*
.0 REM *F I.                         *
. REM *  F -I.R' .. .                *
. REM *.I   ARAMETER                 *
.40 REM  ******************************
.0 I . . . . . .
.20 PEMIH IPA-SSTRE. 0W
.. REM
.  .  .  .  I  I41  .  .A
.40 GOTO10
100 IFK<2927THENPRINT"NUMBER OF
DATA ENTRIES ERRO R  I  .  .I
ZE  .  .  E I
310 IF  2341614 THENPRINT "AE..CUM
ERROR. VALUE  .  .I IE
341614" END
320 REM TO RUN ROUTINES SYS64738
330 REM
340 END
1000 DATA122,128 57 128 1.5 194 205
1010 DATA56,48,133,227 131 164 20.
1020 DATA129,158,130,247,140,54 1.1
1030 DATA76,72,178,0,49,2.4,6
1040 DATA128 71 254,74,245,145,240
1050 DATA14,242,80,242,51,243 241
1060 DATA131,202,241,237,246,62,241
1070 DATA47,243,68,128,165,244 .37
1080 DATA245,32,188,246,32,225 255
1090 DATA240,3 76 114 254 .2,163
1100 DATA257,32 24 229 32 33 1.3
1110 DATA2 204 255,169 0,133,13
1120 DATA32,122 166 68,162 128,76
.170 DATA136,227,162 21 160 1.6,124
1140 DATA195 132 196 160,35,177 195
1150 DATA153,16.,2,136 16,248 169
1160 DATA118,160 131 14.,147,2,144
1170 DATA144,2 .6 147 22,208 12
1180 DATA163,257 32 .0 .2 .2 .21
1190 DATA255,72 32 128,68,32,229
1200 DATA128,32 101 227 169 121 131
1210 DATA52,133 54 133, 6 169 0
1220 DATA133 51,1..  .  1 3 55 .
1230 DATA172 164 1.. 32 45 .2. 164
1240 DATA251,154 .48 1.2,147 1. ..
1250 DATA3. 12,32,42 42,42 42
1260 DATA32,67 .. .4 69 78 68
1270 DATA69,68 .2 54 52 .2 ..
1280 DATA65,33,7. 67,..,26 43
1290 DATA49 32,42 42 42 42 1.
1300 DATA12,.6,5+ 52 75 ..,32
1310 DATA69,77 32 63 69 61 14
```

BASIC LOADER

```
1320 DATA63,[illegible]
1330 DATA169,9,121,[illegible]
1340 DATA16,247,96,32,85,206,[illegible]
1350 DATA34,204,[illegible]
1360 DATA136,[illegible]
1370 DATA[illegible]
1380 [illegible]
1390 [illegible]
1400 [illegible]
1410 DATA1[illegible]
1420 DATA1[illegible]
1430 DATA[illegible]
1440 [illegible]
1450 DATA212,[illegible]
1460 DATA76,196,[illegible]
1470 DATA212,[illegible]
1480 DATA[illegible]
1490 DATA212,[illegible]
1500 DATA[illegible]
1510 DATA65,[illegible]
1520 DATA[illegible]
1530 DATA204,[illegible]
1540 DATA77,69,205,76,79,[illegible]
1550 DATA205,86,85,82,80,64,210
1560 DATA0,[illegible]
1570 DATA39,139,42,139,116,124,45
1580 DATA139,45,139,51,139,54,139
1590 DATA57,139,187,135,60,139,135
1600 DATA137,63,139,66,139,69,139
1610 DATA72,139,75,139,73,139,81
1620 DATA139,84,139,87,139,90,139
1630 DATA93,139,96,139,99,139,102
1640 DATA139,105,139,108,139,111,139
1650 DATA114,139,166,122,160,4,132
1660 DATA15,189,0,2,16,7,201
1670 DATA255,240,43,232,208,244,201
1680 DATA32,240,36,133,8,201,14
1690 DATA240,71,36,15,112,26,201
1700 DATA63,208,4,169,153,208,18
1710 DATA201,45,144,4,201,60,144
1720 DATA10,76,70,130,169,238,44
1730 DATA5,11,164,113,232,200,153
1740 DATA251,1,201,238,240,49,185
1750 DATA251,1,240,34,56,233,58
1760 DATA240,4,201,73,208,2,133
1770 DATA15,56,233,85,208,174,133
1780 DATA8,189,0,2,240,219,197
1790 DATA8,240,215,200,153,251,1
1800 DATA232,208,240,153,253,1,196
1810 DATA123,169,255,133,122,96,165
1820 DATA11,200,153,251,1,76,207
1830 DATA129,132,113,160,255,134,122
1840 DATA202,169,1,133,11,200,232
1850 DATA189,0,2,56,249,241,128
1860 DATA240,245,201,128,240,156,166
1870 DATA122,230,11,200,185,240,128
1880 DATA16,250,185,241,128,208,220
1890 DATA160,0,132,11,136,166,122
1900 DATA202,200,232,189,0,2,56
1910 DATA249,158,160,240,245,201,128
1920 DATA208,3,76,255,129,166,122
1930 DATA230,11,200,185,157,160,16
1940 DATA250,185,158,160,208,225,189
1950 DATA0,2,76,1,130,48,[illegible]
1960 DATA76,243,166,201,255,240,249
1970 DATA36,15,48,245,201,238,240
1980 DATA5,32,217,130,48,3,32
1990 DATA186,130,76,239,166,200,177
2000 DATA95,170,132,73,160,255,202
2001 =0 A=0
2010 DATA240,8,200,185,241,128,16
2020 DATA250,48,245,200,185,241,128
2030 DATA48,5,32,210,255,208,245
2040 DATA96,56,233,127,170,132,[illegible]
2050 DATA160,255,202,240,8,200,[illegible]
2060 DATA158,160,16,250,48,245,200
2070 DATA185,158,160,48,250,32,210
2080 DATA255,208,245,32,117,0,201
2090 DATA238,240,10,201,153,240,38
2100 DATA32,121,0,76,231,167,32
2110 DATA14,131,76,174,167,230,122
2120 DATA208,2,230,123,160,0,177
2130 DATA122,56,233,1,10,168,185
2140 DATA138,129,72,185,137,129,72
2150 DATA76,115,0,32,46,131,76
2160 DATA174,167,173,58,131,72,173
2170 DATA57,131,72,76,115,0,235
2180 DATA132,169,0,133,13,32,115
2190 DATA0,201,238,240,6,32,141
2200 DATA0,76,141,174,230,122,208
2210 DATA2,230,123,160,0,177,122
2220 DATA201,29,176,5,76,5,175
2230 DATA133,26,169,173,72,169,140
2240 DATA72,198,56,165,56,10,170
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BASIC LOADER

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2450 DATA2[illegible],[illegible],141,165,[illegible]
2460 DATA1[illegible],16[illegible],1[illegible],20[illegible]
2470 DATA[illegible],13[illegible],[illegible],20[illegible]
2480 DATA[illegible],22,[illegible],201,16[illegible]
2490 DATA[illegible],1[illegible],204,141,[illegible],240
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2530 DATA[illegible]1,1[illegible]1,20[illegible],16[illegible],0,1[illegible]
2540 DATA[illegible],19[illegible],1[illegible],[illegible],15[illegible],11[illegible]
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2560 DATA1,20[illegible],[illegible],2[illegible],2[illegible]1
2570 DATA17[illegible],[illegible],1[illegible],214,224,[illegible]4
2580 DATA[illegible]0,[illegible],[illegible],1,[illegible],16[illegible]
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2600 DATA20,20[illegible],[illegible],21,[illegible]19
2610 DATA[illegible],16[illegible],1,[illegible],9[illegible],[illegible]08,1[illegible]
2620 DATA[illegible],[illegible]5,1[illegible],20,1[illegible],[illegible]1,16[illegible]
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2670 DATA[illegible],[illegible]04,141,1[illegible],1[illegible]2,1[illegible]
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2720 DATA[illegible],1[illegible],1[illegible]2,0,1,1[illegible],1[illegible]
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2740 DATA42,42,42,42,42,42,[illegible]2
2750 DATA69,[illegible],[illegible],[illegible],7[illegible],[illegible]0,1[illegible]
2760 DATA[illegible],[illegible],79,71,[illegible],[illegible]
2770 DATA[illegible],42,42,42,42,1[illegible],4[illegible]
2780 DATA42,42,42,42,[illegible],4[illegible],1[illegible]
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2810 DATA[illegible]7,201,1[illegible],[illegible]4,24[illegible],[illegible],[illegible]1
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2850 DATA233,132,32,121,0,2[illegible]1,4[illegible]
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2870 DATA158,173,36,13,48,1[illegible],3[illegible]
2880 DATA221,189,32,135,180,[illegible],3[illegible]
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2910 DATA[illegible],[illegible],19,208,16,169,13
2920 DATA[illegible],[illegible]1,[illegible],[illegible],19,[illegible]
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2940 DATA26,56,32,240,255,152,56
2950 DATA23[illegible],10,176,2[illegible]2,[illegible]3,255,105
2960 DATA1,208,25,8,56,32,240
2970 DATA255,1[illegible],9,[illegible]2,155,18[illegible],201
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3020 DATA202,242,76,30,171,32,12
3030 DATA134,32,250,174,32,121,0
3040 DATA32,49,134,176,8,32,69
3050 DATA134,142,111,134,176,66,32
3060 DATA46,134,176,8,32,78,134
3070 DATA142,112,134,176,53,32,46
3080 DATA134,176,8,32,72,134,142
3090 DATA113,134,176,40,32,46,134
3100 DATA176,8,32,72,134,142,114
3110 DATA134,176,27,32,46,134,176
3120 DATA8,32,72,134,142,115,134
3130 DATA176,14,32,46,134,144,3
3140 DATA76,8,175,32,75,134,142
3150 DATA116,134,32,247,174,173,116
3160 DATA134,240,5,169,147,32,22
3170 DATA231,173,113,134,141,134,2
3180 DATA173,114,134,141,33,208,173
3190 DATA115,134,141,32,208,172,141
3200 DATA134,174,112,134,24,76,240
3210 DATA255,56,32,240,255,140,141
3220 DATA134,142,112,134,173,33,208
3230 DATA141,114,134,173,32,208,141
3240 DATA115,134,173,134,2,141,113
3250 DATA134,169,0,141,116,134,96
3260 DATA32,115,0,201,44,208,2
3270 DATA56,96,201,41,240,2,24
3280 DATA96,104,104,32,115,0,76
3290 DATA230,133,169,40,44,169,16
3300 DATA44,169,2,44,169,25,141
3310 DATA110,134,32,158,183,236,110
3320 DATA134,176,14,32,121,0,201
3330 DATA41,240,211,201,44,240,217
3340 DATA76,8,175,162,14,76,55
3350 DATA164,0,0,0,0,0,0
3360 DATA0,32,225,138,32,134,138
3370 DATA133,89,162,0,32,188,137
3380 DATA162,0,32,223,134,134,252
3390 DATA32,218,137,120,173,0,3
3400 DATA141,196,138,173,1,3,141
3410 DATA197,138,169,92,141,0,3
3420 DATA169,138,141,1,3,88,32
3430 DATA232,137,76,179,134,32,93
3440 DATA138,32,238,137,76,167,134
3450 DATA165,252,56,229,34,240,3
3460 DATA76,5,135,164,35,162,64
3470 DATA165,1,41,254,133,1,189
3480 DATA64,191,240,7,145,87,232
3490 DATA200,76,199,134,165,1,9
3500 DATA1,133,1,136,132,35,76
3510 DATA170,134,32,128,138,197,89
3520 DATA240,3,76,8,175,32,128
3530 DATA138,240,17,197,89,240,13
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BASIC LOADER

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3540 DATA157 128 191,232 224 64 208
3550 DATA[illegible] 162 23 76,55 164,169
3560 DATA0 157 128 191 96,160,0
3570 DATA177 87 133,20 200,177,87
3580 DATA133 21 162,0,200 180 35
3590 DATA240,10,177,87,157,0,2
3600 DATA232,224,86,208,241 165,1
3610 DATA41 254 133,1 160 0 185
3620 DATA128 191 240,9,157 0 2
3630 DATA[illegible] 200,224 87 208,242,165
3640 DATA1 9 1 13 1,165 35
3650 DATA24,101 34 168 165,35,24
3660 DATA101,252 133,35,133 35 177
3670 DATA87,157,0,2,200,232,201
3680 DATA0,240 10,224,88,208,241
3690 DATA169,0 157 0 2 232 142
3700 DATA185 135,138,24,105,4 133
3710 DATA11,173 2 3 141 137 135 169
3720 DATA136,141 2 3 169 135,141
3730 DATA3 3,72,139 138 164,11
3740 DATA76 164 164 173 136,165 141
3750 DATA2,7,173,137,133,141 2
3760 DATA3 32,165 136 165,87 197
3770 DATA45,206 6,165 68 137 46
3780 DATA240 15,173 135 135,231,1
3790 DATA240 3 76 170,134 168 2
3800 DATA132,35,162 0 76,173,134
3810 DATA76 75,138 0 0 0,165
3820 DATA46 137 96,165,45 1 3,35
3830 DATA52,229 47,165,96,229,48
3840 DATA144 3,76 167 134 32 137
3850 DATA170,165 37,240,43 201,1
3860 DATA240,71 201,2 240 92,169
3870 DATA87,32,210 255 32 157,136
3880 DATA169,61 32,210,255 160 2
3890 DATA177,95 72,200,177,95,169
3900 DATA104,32 145,179 32,221 189
3910 DATA32 10 171 76,99 136 169
3920 DATA32 32 210 255 32 157 136
3930 DATA169 61 32,210 255,32 137
3940 DATA177 165,71 164 72,72 162
3950 DATA187 32,221 189,32 218 189
3960 DATA76 99 136 32 157,136,169
3970 DATA47,160,136,162 90 171,76
3980 DATA99,136,32,61,32,70 85
3990 DATA78,67 24,73 79,73,0
4000 DATA162,3 189,152 137 32 210
4010 DATA255,224 3,208 3,32 157
4020 DATA138 202,16,240,160 4,177
4030 DATA95 133 35,136,177,95 133
4040 DATA34,136 177,95,32 36,171
4050 DATA169 34 32,210,255,169,13
4060 DATA32,210,255 32,225,255,208
4070 DATA1 96,24,165,95 105 7
4080 DATA133,95,166,96,144,1,232
4090 DATA133,96,76,136,135,160,0
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4110 DATA132,37,200,177,95,10,38
4120 DATA37,34,153,69 0 136,16
4130 DATA244,165,69,32,210,255,165
4140 DATA70,240,3,32,210,255,96
4150 DATA165,70,208,5,169,32,32
4160 DATA210,255,96,169 13,32,210
4170 DATA255,165,47,133 35 165,48
4180 DATA133,96,165,96,197,50,208
4190 DATA[illegible] 165 35 197 48 240 177
4200 DATA[illegible]
4210 DATA[illegible] 10 201 2
4220 DATA[illegible] 169 36 44 169 [illegible]
4230 DATA44 169,[illegible] 10,255 32
4240 DATA151 [illegible] 169 32 [illegible],210 255
4250 DATA169 40 [illegible] 210,255 165 35
4260 DATA[illegible] 3 [illegible] 251 165 96
4270 DATA105 3 1[illegible] 252 170 1 177
4280 DATA251 [illegible] 253 169,0,133,254
4290 DATA[illegible] 36,254 165 [illegible],24
4300 DATA101 251 133 253,165,254,101
4310 DATA252 133 254 160,0 177 251
4320 DATA141 131 137 200,177 253 141
4330 DATA132,137 203,3,206,131 137
4340 DATA206,130,137 171,131 137 174
4350 DATA180 137 164 95 140,170,137
4360 DATA164 96 140,131,1[illegible] 32 205
4370 DATA169 172 140 137,172 95,172
4380 DATA131 137 [illegible],95 165 253
4390 DATA133 [illegible] 165 254,133
4400 DATA0 137 254 137 252 207,6
4410 DATA165 253 137 251 240 2 169
4420 DATA44,32 210 255,76 16 137
4430 DATA160,3,177 95 133,251 136
4440 DATA177,95 24,101,95,133 95
4450 DATA165 96 101 251 133 96 169
4460 DATA41 32 210 255 169 13 32
4470 DATA210 255 76 180 1 6,0 0
4480 DATA24 32 61 56 32 134,148
4490 DATA133,84,162 0 32 168 137
4500 DATA32,218,137 120,173 0 [illegible]
4510 DATA141 196 138 173 1[illegible],141
4520 DATA137,138,163,96 141,0 3
4530 DATA169 163,141,1 3 32 32
4540 DATA202 137 32 90 137,32 202
4550 DATA137 76 137 137 76 8 1 5
4560 DATA32 126 131 240,243,137,60
4570 DATA240 13 157 64 141 202 224
4580 DATA64 208,238,162 23 76 96
4590 DATA164 169 0 157 64 191 1 4
4600 DATA34,96 169 40 24,105 2
4610 DATA131,87 165 44,133 0 133
4620 DATA88,96 162 0 160 2 162
4630 DATA5 165,1 41 254,1,3,1
4640 DATA177 3 1,240,23 221 64 191
4650 DATA8,165,1 9 1,190,1
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BASIC LOADER

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4660 DATA40,208,7,200,232,228,34
4670 DATA208,227,96,230,35,164,35
4680 DATA162,0,177,87,240,3,76
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4700 DATA1,165,87,56,233,2,133
4710 DATA87,165,88,233,0,133,88
4720 DATA160,0,177,87,133 89,200
4730 DATA177,87,133,88 5,89,240
4740 DATA16 165,89 24,105,2,133
4750 DATA87,165 88 105 0 133,88
4760 DATA76,232,137,120,173,196,138
4770 DATA141,0,3,173,197,138,141
4780 DATA1,3,88,76,116,164,96
4790 DATA160,0,32,139,138,169,145
4800 DATA32,210,255,177,87,133,20
4810 DATA200,177,87,133,21,32,19
4820 DATA166,32,201,166,32,165,138
4830 DATA230,35,164,35,162,0,96
4840 DATA230,122,208,2,230,123 160
4850 DATA0,177,122,96,165,34,141
4860 DATA191 138,165,35,141,192,139
4870 DATA165,87,141,193,139,165 88
4880 DATA141,194 138 165 252,141 195
4890 DATA1,8 96 173 191,138 138 24
4900 DATA173,192,138,133,35,173,193
4910 DATA138,133,87,173,194,138,133
4920 DATA88,173,195,138,133 250 96
4930 DATA0,0,0,0,0,0
4940 DATA169,0,133,10,32,213 255
4950 DATA169,0,133,135,165 45 50
4960 DATA233,2,170,165,46 233 0
4970 DATA168,165,10,32,213,255,32
4980 DATA51,165,165,45,164,46,56
4990 DATA 51,2 133,87,152,233 0
5000 DATA133,88,160,0,177,87,208
5010 DATA27,200,177,87,208,22,165
5020 DATA87,24,105,2,133,45,133
5030 DATA47,133,49 165 88,105 0
5040 DATA133,46,133,48,133,50,96
5050 DATA160,0,177,87,133,89,200
5060 DATA177,87 133,88,165,89,133
5070 DATA87,76,242,138,76,113,168
5080 DATA76,8,175,76,8,175,76
5090 DATA8,175,76,8,175,76,8
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5110 DATA76,8,175,76,8,175,76
5120 DATA8,175,76,8,175,76,8
5130 DATA175,76,8,175,76,8,175
5140 DATA76 8 175,76,8 175 76
5150 DATA8,175,76,8,175,76,8
5160 DATA175,76,8,175,76,8,175
5170 DATA76 8 175 76 8 175,76,999
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Your Commodore's man in the States, Burton Rubin, attended the launch of the Amiga. Here's his report plus Brendin Lewis's impressions of Metacomco — makers of Amigados.

THE AMIGA

US View

FOR THE PAST TWO YEARS, WISPS OF rumours, as insubstantial as smoke, have appeared in various magazines concerning the fabled, long awaited, Amiga computer. Originally called the Lorraine, the product of the Amiga Corporation, the machine, a 32 bit computer with fabulous graphic and sound capability, was to be the ultimate home computer.

Silicon Valley, as we all know, is littered with the bones of "ultimate home computers" Timex-Sinclair, Texas Instruments, Coleco, Mattel, and even the mighty IBM have all seen their offerings for the home market wither away to a dusty death. When Jack Tramiel left Commodore, there was some speculation that his plan might be to purchase Amiga, (and with it, the rights to the wonderous Lorraine) and use the new machine as the saviour of the almost moribund Atari. By purchasing, Amiga, Commodore beat Atari to the punch.

Commodore first exhibited the machine at the June, 1984 Consumer

The Amiga Specifications

Machine:	Commodore Amiga
Processor:	68000 at 7MHz
RAM:	256K standard; 256K expansion slot, Up to Mb 192K operating system
Graphics:	320 × 200 32 colours, 320 × 400 32 colours 640 × 200 16 colours, 640 × 400 16 colours Colours selected from a palette of 4096
Sound:	Four audio channels including stereo and speech
Disk:	3½ inch floppy 880Kb
Software:	Amigados, speech, Basic, Graphics
Miscellaneous:	Peripherals: Videodisk unit, hard disk plus 1M byte RAM, colour monitor, modem. Three custom chips inside the Amiga take much of the processing burden away from the 68000. The very high speed graphics are handled by one of these chips

UNVEILED

Electronics show and its specifications were impressive The Motorola 68000 was chosen for the central processing unit. This is a 32 bit chip with a 16 bit bus. Capable of addressing up to 16 megabytes of memory, it is the same chip that powers the Apple Macintosh. Tramiel's riposte was the 130ST and 520ST, 32 bit machines running GEM. The Commodore camp responded with.. silence. Sure, there was plenty on the sparkling, rational new 128, and even pictures and publicity on the new notebook computer. But Commodore breathed nary a word about the Lorraine, and the rumours continued to fly

At the official premier of the Amiga computer, hosted (quite grandly) by Commodore at the Vivian Beaumont theatre at Lincoln Centre, the rumours all came true

The specifications do not convey the power of the machine. The standard configuration of the Amiga includes a Motorola 68000 microprocessor, running at almost eight MHz, with 256K of RAM, nternally expandable to 512K. The speed of this microprocessor is further abetted by a proprietary three chip set which frees the 68000 from routine graphic and I/O tasks

The Amiga is controlled by an 89 key keyboard with numeric keypad, cursor and special function keys, or a two button mouse. It features a built in three and a half inch disk drive (880K formatted), 80 × 25 line text display, 640 × 400 resolution and a palette of 4,096 colours (of which any 16 can be on the screen at one time in high resolution mode) There are parallel serial and second drive ports, two reconfigurable joystick ports, as well as text to voice and professional quality four channel multi-voice music synthesis capability. ABasIC, Amiga ODS, and Amiga Tutor will be bundled with the machine

Software availability, the bane of a new computer introductions, would seem not to be a problem here Thanks to the Emulator – a software option – the Amiga can run IBM PC compatible software packages like Lotus 1-2-3. Wordstar, and D Base III, in either 3.5 or 5.25 inch disk format

In addition, when introduced in September, the Amiga will have available more than 20 programs including word processing, accounting, productivity education, speech synthesis, telecommunications, paint, animation, and graphic programs. Assembler, C, Pascal Logo, and Lisp will be available at the time of introduction, as well as a very powerful version of Microsoft Basic. Third party publishers will have more than 20 games available when the machine hits the shelves. Arktronics has already completed work on a videodisk interface

The Amiga works through the now familiar system of menus, windows, icons multitasking, and a mouse – first pioneered by Apple with the Lisa. Up to 50 windows can be open and running on the Amiga, though this is obviously more than anyone can manipulate without going insane. The Intuition operating system, working through a system of "gadgets" makes windowing an easier and quicker task than it is on the Macintosh, or with the GEM operating system of the Atari

The animation power of the machine is almost beyond description It should open new vistas for anyone who needs professional visual aids. Its value to the small advertising agency, or any small business should be incalculable Combined with the phenomenal multitasking capability, Amiga should be a formidable weapon in the business wars.

With business applications firmly in mind, Commodore has chosen to merchandise the machine through specialist dealers Long ago, Commodore pulled the plug on computer stores, in favour of mass market merchants

The powers at Commodore are reversing the decision that made them such a commercial success and critical failure. It remains to be seen just how easily Commodore will be accepted by the same computer stores which were abandoned a few years ago

At a list price of $1295, the Amiga represents excellent value. However, it's unlikely to be found at the local K Mart

My feeling is that acceptance in the computer stores may come gradually, but it will definitely come The machine is simply too good to be ignored The $1295 price tag includes a healthy mark-up for the dealers, and Commodore has signed up 800 RCA service locations to provide service support. With the advent of the Amiga, Commodore has both Apple and IBM lined up in its sights

Thomas Rattigan, president of Commodore North America, is talking tough. "Commodore" he says, "is a strong, lean, aggressive, organization", and he intends to have the Amiga showcased in 10,000 outlets within a year of its introduction. He feels that the Amiga is a great leap forward (shades of Sir Clives QL!)

Irving Gould, Chairman of the company, sees the future of Commodore in "sophisticated, high end systems", with "excellent price/performance ratios" and "a full, rich, product line". That doesn't sound like the marketing philosophy that we've all grown to know and love

The Amiga, though, is a machine capable of changing the philosophy of a company. Where the trusty old 64 was a Ford, and the Plus Four an Edsel, the Amiga is a Ferrari. The ultimate decisions will be made in the marketplace. Don't bet against the Amiga

The UK Connection

Tucked away in the corner of a small square in Bristol is the software house Metacomco. What is Metacomco? It is the company which has written Amigados, the operating system for the new Commodore Amiga Metacomco is not a large company – with a staff of 25 – but it does have a good track record, working on software for both the Sinclair QL and the Atari 520ST

Upon meeting a few of the staff it's quite easy to see that the firm's success is based on three main factors – sound management, expertise and, most notably, enthusiasm. Even some members of the senior management seem like small children playing with a new toy whenever the Amiga is mentioned Even this cynical reporter was surprised at its performance Though, as ever I'm still not totally convinced, I'll reserve final judgement for the full production model Metacomco's staff, on the other hand, have had the word cynical totally erased from their memories It was difficult for them to see a market into which the Amiga would not fit

The whole story really started about three years ago when Amiga Inc. started work on a new machine In November 1984, Commodore took over Amiga and thus the machine Previous to this though, Commodore had already approached Metacomco concerning Tripos (which is the framework around which Amigados is built) From here, Metacomco has never looked back and has written various bits of software for the Amiga, including a version of Basic

Although, for most of the day it was difficult to stop our host talking, I did finally get an ominous silence when I broached the subject of Amiga II. The only reply I did get was that, due to the open technology of the Amiga, the Japanese would be the first to produce an Amiga look-a-like and that ideas were already in the pipeline for something within the next 12 months

Finally, my thanks to all at Metacomco for a very enjoyable day, and for providing what Commodore UK could not (or would not), a look at the Amiga

Split your 64's memory with this useful little program from Ray Green.

SPLIT 64

Introduction

WHEN USING YOUR C64 TO develop Basic programs there are times when it would be useful to have another machine set up close to hand in order to run small utility programs, for instance hex conversion, address calculation, etc. In schools, two pupils sharing one machine must be working on the same program unless a very disciplined approach is used. Split 64 is my attempt to solve these problems without incurring the cost of an extra machine.

Method

The program splits Basic memory into two areas of just over 16K allowing the machine to hold two different Basic programs at the same time. Switching between areas is achieved by holding down the shift key and pressing the control key. Each area maintains the screen information from the last time you used it. The variable contents also remain intact. The second screen information is stored at the top of memory leaving approximately 3K free for things like centronics interface software. The area from $C000 is also free for utilities.

In the initial start up of the program, I set the screen colours up to the normal blue for area (a) and green for area (b). If these are not to your liking then just change them with the normal POKEs and the colours you set will be stored when switching between areas. If while using this program, run/stop restore is pressed, then as normal the screen will reset to blue and clear. However, the shift control switch will no longer work so to re-start Split 64 without losing your programs, type SYS (35896) [return]. SYS (35840) resets split 64 completely.

Basic Loader

```
1 REM ********************************
2 REM *                              *
3 REM *  R. GREEN    1/2/85          *
4 REM *                              *
5 REM ********************************
6 A=35840
10 PRINT"[CLEAR][DOWN][RIGHT][RIGHT][RIG
HT][RIGHT][RIGHT][RIGHT][RIGHT][RIGHT][R
IGHT][RIGHT][RIGHT][RIGHT][RIGHT][RIGHT]
[RIGHT][RIGHT][RVSON]SPLIT 64[RVSOFF]"
15 PRINT"[DOWN][DOWN][DOWN][DOWN][DOWN][
DOWN][DOWN][DOWN][DOWN][DOWN][RIGHT][RIG
HT][RIGHT][RIGHT][RIGHT][RIGHT][RIGHT][R
IGHT][RIGHT][RIGHT][RIGHT][RIGHT][RIGHT]
[RIGHT][RIGHT] WORKING"
20 READD
25 C=C+D
30 IFD<0THEN40
35 POKEA,D:A=A+1:GOTO20
40 IFC=37269THENSYS(35840)
45 PRINT"[DOWN][DOWN]ERROR IN DATA"
50 DATA162,16,189,46,141,141,134,2,202,1
55 DATA46,141,141,33,208,202,189,46,141,
141
60 DATA32,208,202,189,46,141,149,43,202,
16
65 DATA248,162,2,169,0,157,0,8,157,0
70 DATA74,202,16,247,32,34,228,32,120,14
0
75 DATA32,34,228,32,120,140,120,173,20,3
80 DATA72,173,21,3,72,169,87,141,20,3
85 DATA169,140,141,21,3,104,141,81,141,1
04
90 DATA141,80,141,88,76,116,164,173,141,
2
95 DATA201,5,208,23,165,207,208,19,165,1
57
100 DATA201,128,208,13,32,120,140,162,25
5,160
105 DATA255,136,208,253,202,208,248,108,
80,141
```

BASIC Loader (continued)

```
110 DATA162,16,173,134,2,72,189,63,141,1
41
115 DATA134,2,104,157,63,141,202,173,33,
208
120 DATA72,189,63,141,141,33,208,104,157
,63
125 DATA141,202,173,32,208,72,189,63,141
,141
130 DATA32,208,104,157,63,141,202,181,43
,72
135 DATA189,63,141,149,43,104,157,63,141
,202
140 DATA16,241,162,0,189,0,4,72,189,82
145 DATA141,157,0,4,104,157,82,141,189,0
150 DATA216,72,189,93,145,157,0,216,104,
157
155 DATA93,145,189,0,5,72,189,82,142,157
160 DATA0,5,104,157,82,142,189,0,217,72
165 DATA189,93,146,157,0,217,104,157,93,
146
170 DATA189,0,6,72,189,82,143,157,0,6
175 DATA104,157,82,143,189,0,218,72,189,
93
180 DATA147,157,0,218,104,157,93,147,189
,0
185 DATA7,72,189,82,144,157,0,7,104,157
190 DATA82,144,189,0,219,72,189,93,148,1
57
195 DATA0,219,104,157,93,148,232,224,0,2
08
200 DATA139,96,1,8,3,8,3,8,3,8
205 DATA0,74,0,74,0,74,254,246,14,1
210 DATA74,3,74,3,74,3,74,0,140,0
215 DATA140,0,140,245,240,13,0,0,-1
```

Entering the Program

To enter the program type in the Basic loader program, then SAVE it. Type RUN and the screen shou d flash, then clear to the normal Basic start up message. Note the much reduced free memory. Type in a short Basic program and RUN it. Stop the program, hold down the shift key and press control. The screen should now change colour and have the Basic start up message on it.

You are now in the second area. LIST and there should be no trace of the program you typed in. Shift control should take you back to the first screen and LIST w ll show your program is still there. If you wish to make a machine code copy of split 64 then first make sure you are in program area (a) before entering your machine code monitor. The start address is $8C00 and the end address $8D52.

How it Works — General

Split 64 takes advantage of the fact that the C64 operating system allows Basic to work within any free area of memory. To write your programs in another area of memory it is only necessary to change the pointers used by Basic in zero page. Change the pointers back and any program that was there before will stil be there. It is also possible to change the area of memory used by the screen but when writing this program it was decided to store the second screen along with the second colour map above Basic memory. The shift control switch is operated by a simple interrupt wedge.

How it Works — Machine Code

Initialise Routine

This routine sets up area (a) colours, memory start, memory end, and variable pointers from values fixed in Table 1. It then puts zero in the first three ocations of Basic memory for areas (a) and (b). It then calls the swap routine, which stores the current screen and loads the contents of the second screen (rubbish at this time). Having swapped screens the Basic start up program is called which clears the screen and prints the start up message. This procedure is then repeated for area (a). Finally the wedge routine address is inserted into the IRQ vector, the normal vector address having been saved, then back to basic.

Wedge Routine

The wedge routine is entered on every IRQ. It first checks ocation $028D to see if the shift control keys are pressed. If not it jumps to the normal IRQ routine. If the keys are pressed, it checks that the cursor is off and that the computer is not in RUN mode. When all three of these conditions are satisfied it calls the swap routine. After swapping areas a large delay loop is executed to avoid multiple swaps. Control is then passed to the normal IRQ routine.

Swap Basic

This is the first part of the swap subroutine. A loop is used to exchange the current screen, border and character colours with the contents of Table 2. The same loop is used to exchange the Basic pointers ($2B-$38) again with the contents of Table 2. On start up Table 2 contains the fixed values for area (b).

Swap Screen

Once more a loop is employed to exchange the current screen and colour map stored above Basic memory. The exchange is done eight bytes at a time. Not the most elegant way to swap four areas of memory but it was chosen to cause minimum disruption to the screen during the swap

INITIALISE ROUTINE

```
8c00 a2 10      ldx #$10        :index to table1
8c02 bd 2e 8d   lda $8d2e,x     :table1
8c05 8d 86 02   sta $0286       :char. colour area a
8c08 ca         dex             :next
8c09 bd 2e 8d   lda $8d2e,x     :table1
8c0c 8d 21 d0   sta $d021       :screen colour area a
8c0f ca         dex             :next
8c10 bd 2e 8d   lda $8d2e,x     :table1
8c13 8d 20 d0   sta $d020       :border colour area a
8c16 ca         dex             :next
8c17 bd 2e 8d   lda $8d2e,x     :table1
8c1a 95 2b      sta $2b,x       :basic memory size area a
8c1c ca         dex             :
8c1d 10 f8      bpl $8c17       :next
8c1f a2 02      ldx #$02        :
8c21 a9 00      lda #$00        :zero first 3 bytes in
8c23 9d 00 08   sta $0800,x     :both area a&b
8c26 9d 00 4a   sta $4a00,x     :
8c29 ca         dex             :
8c2a 10 f7      bpl $8c23       :
8c2c 20 22 e4   jsr $e422       :basic start up a
8c2f 20 78 8c   jsr $8c78       :swap area
8c32 20 22 e4   jsr $e422       :basic start up b
8c35 20 78 8c   jsr $8c78       :swap back
8c38 78         sei             :
8c39 ad 14 03   lda $0314       :irq low
8c3c 48         pha             :save it
8c3d ad 15 03   lda $0315       :irq high
8c40 48         pha             :save it
8c41 a9 57      lda #$57        :low address wedge
8c43 8d 14 03   sta $0314       :irq vector
8c46 a9 8c      lda #$8c        :high address wedge
8c48 8d 15 03   sta $0315       :irq vector
8c4b 68         pla             :recover address irq high
8c4c 8d 51 8d   sta $8d51       :store
8c4f 68         pla             :recover address irq low
8c50 8d 50 8d   sta $8d50       :store
8c53 58         cli             :
8c54 4c 74 a4   jmp $a474       :ready for basic
```

Table 2

```
WEDGE ROUTINE

8c57 ad 8d 02     lda $028d       :control shift pressed
8c5a c9 05        cmp #$05        :
8c5c d0 17        bne $8c75       :if not goto normal irq
8c5e a5 cf        lda $cf         :cursor off
8c60 d0 13        bne $8c75       :if not goto normal irq
8c62 a5 9d        lda $9d         :direct mode
8c64 c9 80        cmp #$80        :
8c66 d0 0d        bne $8c75       :if not goto normal irq
8c68 20 78 8c     jsr $8c78       :swap area
8c6b a2 ff        ldx #$ff        :
8c6d a0 ff        ldy #$ff        :
8c6f 88           dey             :delay to avoid key bounce
8c70 d0 fd        bne $8c6f       :
8c72 ca           dex             :
8c73 d0 f8        bne $8c6d       :
8c75 6c 50 8d     jmp ($8d50)     :jump to normal irq routine
```

Table 3

```
SWAP BASIC Z.PAGE LOCATIONS

8c78 a2 10        ldx #$10        :index to table2
8c7a ad 86 02     lda $0286       :char colour current
8c7d 48           pha             :save it
8c7e bd 3f 8d     lda $8d3f,x     :table2
8c81 8d 86 02     sta $0286       :change char colour
8c84 68           pla             :recover char colour
8c85 9d 3f 8d     sta $8d3f,x     :store in table2
8c88 ca           dex             :next
8c89 ad 21 d0     lda $d021       :current screen colour
8c8c 48           pha             :save it
8c8d bd 3f 8d     lda $8d3f,x     :table2
8c90 8d 21 d0     sta $d021       :change screen colour
8c93 68           pla             :recover screen colour
8c94 9d 3f 8d     sta $8d3f,x     :store in table2
8c97 ca           dex             :next
8c98 ad 20 d0     lda $d020       :current border colour
8c9b 48           pha             :save it
8c9c bd 3f 8d     lda $8d3f,x     :table2
8c9f 8d 20 d0     sta $d020       :change border colour
```

Table 3 continued

```
8ca2 68          pla          :recover border colour
8ca3 9d 3f 8d    sta $8d3f,x  :store in table2
8ca6 ca          dex          :next
8ca7 b5 2b       lda $2b,x    :basic memory size
8ca9 48          pha          :save
8caa bd 3f 8d    lda $8d3f,x  :table2
8cad 95 2b       sta $2b,x    :basic memory size
8caf 68          pla          :recover
8cb0 9d 3f 8d    sta $8d3f,x  :store in table2
8cb3 ca          dex          :next
8cb4 10 f1       bpl $8ca7    :repeat for other z.page
                               locations
```

Table 4

```
SCREEN SWAP ROUTINE

8cb6 a2 00       ldx #$00     :index for screen+colour mem
8cb8 bd 00 04    lda $0400,x  :screen mem
8cbb 48          pha          :save it
8cbc bd 52 8d    lda $8d52,x  :second screen
8cbf 9d 00 04    sta $0400,x  :store in screen
8cc2 68          pla          :recover
8cc3 9d 52 8d    sta $8d52,x  :store in second screen
8cc6 bd 00 d8    lda $d800,x  :colour mem
8cc9 48          pha          :save it
8cca bd 5d 91    lda $915d,x  :second colour mem
8ccd 9d 00 d8    sta $d800,x  :store in colour mem
8cd0 68          pla          :recover
8cd1 9d 5d 91    sta $915d,x  :store in second colour mem
8cd4 bd 00 05    lda $0500,x  : ------------------------
8cd7 48          pha          :
8cd8 bd 52 8e    lda $8e52,x  :
8cdb 9d 00 05    sta $0500,x  :
8cde 68          pla          :
8cdf 9d 52 8e    sta $8e52,x  :    same but plus 256
8ce2 bd 00 d9    lda $d900,x  :
8ce5 48          pha          :
8ce6 bd 5d 92    lda $925d,x  :
8ce9 9d 00 d9    sta $d700,x  :
8cec 68          pla          :
8ced 9d 5d 92    sta $925d,x  : ------------------------
8cf0 bd 00 06    lda $0600,x  :
8cf3 48          pha          :
```

Table 4 (continued)

```
8cf4 bd 52 8f     lda $8f52,x     :
8cf7 9d 00 06     sta $0600,x     :
8cfa 68           pla             :    same but plus 512
8cfb 9d 52 8f     sta $8f52,x     :
8cfe bd 00 da     lda $da00,x     :
8d01 48           pha             :
8d02 bd 5d 93     lda $935d,x     :
8d05 9d 00 da     sta $da00,x     :
8d08 68           pla             :
8d09 9d 5d 93     sta $935d,x     : ----------------------------
8d0c bd 00 07     lda $0700,x     :
8d0f 48           pha             :
8d10 bd 52 90     lda $9052,x     :
8d13 9d 00 07     sta $0700,x     :
8d16 68           pla             :    same but plus 768
8d17 9d 52 90     sta $9052,x     :
8d1a bd 00 db     lda $db00,x     :
8d1d 48           pha             :
8d1e bd 5d 94     lda $945d,x     :
8d21 9d 00 db     sta $db00,x     :
8d24 68           pla             :
8d25 9d 5d 94     sta $945d,x     : ----------------------------
8d28 e8           inx             :next
8d29 e0 00        cpx #$00        :255 done in each block
8d2b d0 8b        bne $8cb8       :if not then go back
8d2d 60           rts             :return
```

Table 5

```
TABLES

Contents shown as at start.


Table1                    Table2

8d2e 01 :low s.a          8d3f 01
8d2f 08 :high "           8d40 4a
8d30 03 :low e.a          8d41 03
8d31 08 :high "           8d42 4a
8d32 03 :low s.arrays     8d43 03
8d33 08 :high    "        8d44 4a
8d34 03 :low e.arrays     8d45 03
8d35 08 :high    "        8d46 4a
8d36 00 :low b/active string  8d47 00
8d37 4a :high    "        "    8d48 8c
8d38 00 :low t/ "         "    8d49 00
8d39 4a :high    "        "    8d4a 8c
8d3a 00 :low mem top          8d4b 00
8d3b 4a :high "   "           8d4c 8c
8d3c fe :screen colour        8d4d f5
8d3d f6 :border colour        8d4e f0
8d3e 0c :char colour          8d4f 0d

Address for IRQ.

8d50 31
8d51 ea
```

PROGRAMMING PROJECTS

This month Garry Marshall shows you how to create artificial landscapes on your 64.

Graphic landscapes

The project

COMPUTER-GENERATED GRAPHICS are increasingly finding their way into films. Among the most impressive and realistic effects that have been seen are the entirely artificial landscapes created for some of the *Star Wars* films. This month's project involves the creation of an artificial landscape of this kind.

Of course, far more sophisticated (and expensive!) equipment than a C64 is needed to display graphics of a quality that is suitable for use in films. But, as we shall see, it is not too difficult to write programs that produce the basic effects, and the quality of the results is surprisingly good.

The theory the provides the basis for the creation of these landscapes is known as fractal geometry. Without going too deeply into the theory, the idea behind a fractal curve is that it is not one or two-dimensional, but has a dimension which is a fraction. Curves of this kind describe, for example, rough surfaces, with the degree of roughness determining the fraction giving the dimension of the fractal curve. They also describe many other naturally occurring curves, such as coast lines and hillsides, and this is what makes them eminently suitable for simulating landscapes.

The project involves starting with a triangle and, by means of a simple procedure deriving from fractal geometry, sub-dividing it to give a graphic display that resembles a mountain. The further the sub-division process is carried out, the more realistic the result will appear.

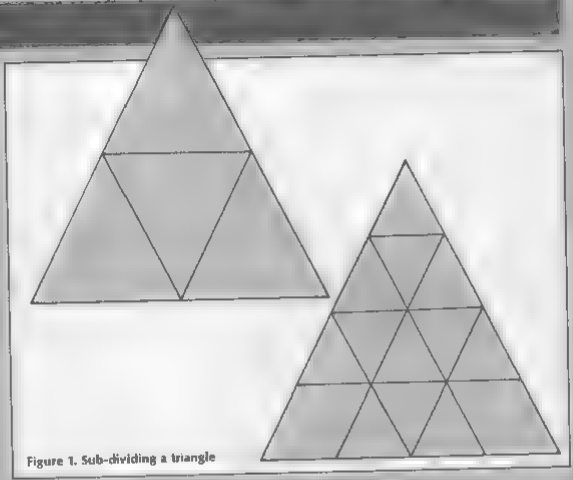


Figure 1. Sub-dividing a triangle

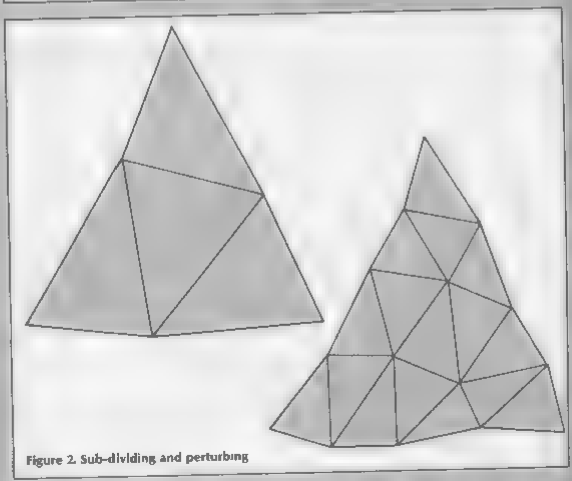


Figure 2. Sub-dividing and perturbing

The solution

The basic idea of the procedure for creating the mountain landscape is illustrated in Figures 1 and 2. The first figure shows that taking a triangle, finding the mid-points of its sides and joining them gives four smaller triangles. Repeating the process on each of the smaller triangles gives a finer triangular mesh, and the more it is repeated, the

ther the triangular mesh becomes. But the results of this procedure do not resemble any natural phenomenon simply because of their regularity. This is not a property to be found in nature which is characterised by randomness.

We can produce an element of randomness by perturbing the mid point of each side by a random amount the variation of which is proportional to the length of its side. The left-hand illustration in Figure 2 shows the result of doing this and drawing the four smaller triangles produced by one sub division. The right hand illustration shows what happens after two sub divisions, demonstrating that none of the triangles can be drawn until all the mid-points have been found and then perturbed. Continuing this process will give an increasingly mountainous display. The range of the perturbation for the mid-point of each side or if you like the degree of proportionality between the range and the length of the side effectively determines the fractional dimension of the final result. Different values for the range give quite different appearances to the mountain landscapes.

This gives us the following form for a graphics program to draw an artificial mountain landscape. It should declare the arrays to be used and then we have several, because we must store the points for all the triangles in the final display as we cannot draw any of them until all their positions have been computed. Then it must read the co-ordinates of the corners of the basic triangle, prepare the high-resolution graphics screen and carry out the sub-division of each side to give the points at the corners of the resulting triangles. To begin with, we will ignore the perturbations of the mid-points that introduce the randomness. This simplifies the program a little, gives results such as those in Figure 1, but provides a program which we can easily generalise to produce results like those in Figure 2. Finally when the program has found the points for all the triangles it only remains to plot them.

The main program based on this scheme is:

```
10 DIMX(48), Y(48), S(3), T(3), U(12), V(12),
XT(48), YT(48)
20 FOR K=1 TO 3
30 READ X(K), Y(K)
40 NEXT K
50 DATA 150, 50, 250, 150, 50, 150
60 GOSUB500. REM HI-RES SCREEN
70 FOR N=0 TO 1
80 FOR K=1 TO 4^N
90 GOSUB 4000. REM SUB-DIVIDE THE
TRIANGLES
100 NEXT K
110 FOR K=1 TO 4^(N+1)*3
120 X(K)=XT(K): Y(K)=YT(K)
130 NEXT K
140 NEXT N
150 FOR K=1 TO 16
160 FOR J=1 TO 3
170 S(J)=X(J+3*(K-1))  T(J)=Y(J+3*(K-1))
180 NEXT J
190 GOSUB 3000: REM PLOT EACH TRIANGLE
200 NEXT K
210 END
500 POKE 53272, PEEK(53272) OR 8
510 POKE 53265, PEEK(53265) OR 32
520 FOR I=8192 TO 16192: POKE I, 0: NEXT I
530 FOR I=1024 TO 2023: POKE I, 22: NEXT I
540 RETURN
1000 RO=INT(R/8): CO=INT(C/8)
1010 L=R AND 7
1020 BIT=7 - (C AND 7)
1030 BYTE=8192 + RO*320 + CO*8 + L
1040 POKE BYTE, PEEK(BYTE) OR 2^BIT
1050 RETURN
2000 DX=X2-X1: DY=Y2-Y1
2010 IF DX=0 THEN 2070
2020 FOR C=X1 TO X2 STEP SGN(DX)
2030 R=INT(Y1+(C-X1)*DY/DX)
2040 GOSUB 1000  REM PLOT POINT
2050 NEXT C
2060 RETURN
2070 C=X1
2080 FOR R=Y1 TO Y2 STEP SGN(DY)
2090 GOSUB 1000: REM PLOT POINT
2100 NEXT R
2110 RETURN
3000 X1=S(3): Y1=T(3)
3010 FOR P=1 TO 3
3020 X2=S(P). Y2=T(P)
3030 GOSUB 2000  REM DRAW LINE
3040 X1=X2  Y1=Y2
3050 NEXT P
3060 RETURN
4000 FOR M=1 TO 3
4010 S(M)=X(M+3*(K-1))  T(M)=Y(M+3*(K-1))
4020 NEXT M
```

Program Listing

```
150 FOR K=1 TO 16
160 FOR J=1 TO 3
170 S(J)=X(J+3*(K-1)) : Y(J+3*(K-1))
180 NEXT
190 GOSUB 3000 : REM PLOT EACH
TRIANGLE
200 NEXT K
210 END
```

Here the arrays are declared in line 10. The data, which is at line 50 and gives the positions of the corners of the initial triangle, is read by lines 20 to 40. Line 60 calls the now familiar subroutine starting at line 500, for preparing the high resolution graphics screen.

Lines 70 to 140 calculate and store the positions of the corners of all the triangles that result from the sub-dividing process. The outer loop variable N determines how many stages of sub-division occur. In the program as presented there are two stages, which are necessary to bring us to the position shown in the right hand illustration of Figure 1. The first sub-division is done with N=0 and the second with N=1.

The inner loop variable, K, counts the number of triangles to be sub-divided. Initially there will be one and the value of 4^N when N=0 is 1. After the first sub-division there will be four, the value

Program Listing (cont.)

```
4030 GOSUB 5000: REM SUB-DIVIDE THIS TRIANGLE
4040 FOR M=1 TO 12
4050 XT(M+12*(K-1))=U(M): YT(M+12*(K-1))=V(M)
4060 NEXT M
4070 RETURN
5000 A1=(S(1)-S(2))*0.2*(RND(0)-0.5)
5010 B1=(S(1)-S(3))*0.2*(RND(0)-0.5)
5020 C1=(S(2)-S(3))*0.2*(RND(0)-0.5)
5030 A=0.5*(S(1)+S(2))+A1
5040 D=0.5*(T(1)+T(2))+A1
5050 B=0.5*(S(1)+S(3))+B1
5060 E=0.5*(T(1)+T(3))+B1
5070 C=0.5*(S(2)+S(3))+C1
5080 F=0.5*(T(2)+T(3))+C1
5090 U(1)=S(1): U(4)=S(2): U(7)=S(3)
5100 V(1)=T(1): V(4)=T(2): V(7)=T(3)
5110 U(2)=A: U(6)=A: U(12)=A
5120 V(2)=D: V(6)=D: V(12)=D
5130 U(3)=B: U(8)=B: U(11)=B
5140 V(3)=E: V(8)=E: V(11)=E
5150 U(5)=C: U(9)=C: U(10)=C
5160 V(5)=F: V(9)=F: V(10)=F
5170 RETURN

READY.
```

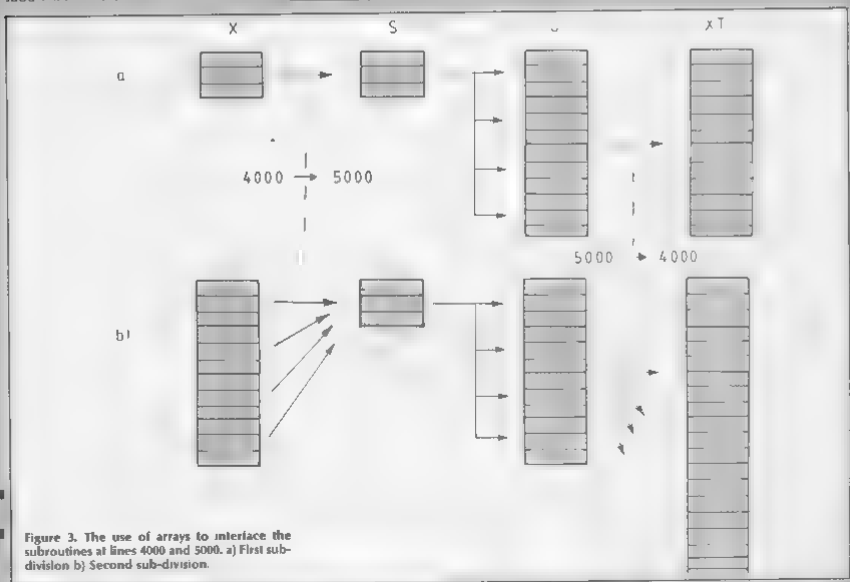
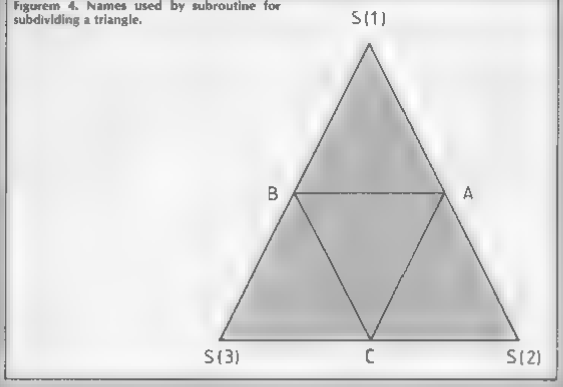


Figure 3. The use of arrays to interface the subroutines at lines 4000 and 5000. a) First sub-division b) Second sub-division.



Figurem 4. Names used by subroutine for subdividing a triangle.

of 4^N when N=1. (Although the program, as listed, goes no further than this, after the second sub-division each of four triangles will have been divided into four to give 4*4 or 4^2 triangles, and so on. In this way, the program is ready to be extended to create more detailed graphics)

Line 90 calls a subroutine starting at line 4000 to sub-divide the triangles that are repeatedly passed to it. This subroutine places the x and y co-ordinates of the corners of the triangle that is being dealt with in the arrays S and T. Then it calls the subroutine starting at line 5000 to do the actual sub-division. After it has done the dividing up, this subroutine leaves the x and y co-ordinates of the corners of the four triangles that result from the sub-division in the arrays U and V, respectively. The contents of these arrays are then transferred to the arrays XT and YT. This gives us the subroutine as

```
4000 FOR M=1 TO 3
4010 S(M)=X(M+3*(K-1)): T(M)=Y(M+3*
     K-1))
4020 NEXT M
4030 GOSUB 5000 REM SUB-DIVIDE THIS
     TRIANGLE
4040 FOR M=1 TO 12
4050 XT,M+12*(k-1))=U(M): YT(M+12*(K-
     1 =V M
4060 NEXT M
4070 RETURN
```

The interface between the subroutines starting at 4000 and 5000 is illustrated in Figure 3, showing how they communicate by means of the arrays. The top illustration shows what happens with the initial sub-division. This does not exactly make it clear that all the arrays are needed, but the bottom illustration does so by showing how the arrays are used for the second sub-division

Figure 4 shows how the x co-ordinates of the corners of a triangle are named during a sub-division as performed by the subroutine starting at line 5000. The subroutine itself is

```
5000 A=0.5*(S(1)+S(2)
5010 D=0.5*(T(1)+T(2))
5020 B=0.5*(S(1)+S(3))
5030 E=0.5*(T(1)+(T(3))
5040 C=0.5*(S(2)+S(3))
5050 F=0.5* T 2)+T(3
5060 U 1)=S(1 U 4=S 2 U(7 S(3
5070 V 1=T 1) V(4)=T(2) V 7=T(3)
5080 U(2) A U 6)=A U(12 =A
5090 V(2)=D V(6)=D: V(12)=D
5100 U(3)=B U(8)=B, U(11)=B
5110 V(3)=E: V(8)=E: V(11)=E
5120 U(5)=C: U(9)=C: U(10)=C
5130 V(5)=F. V(9)=F; V(10)=F
5140 RETURN
```

After this, lines 110 to 130 copy copy the positions of the triangles fromXT and YT to X and Y so that they will be available for the next round of sub-dividing

When the positions of all the triangles have been found they are plotted by lines 150 to 200. Here the inner loop from line 160 to 180, controlled by J, passes the co-ordinates of each triangle in turn to the arrays S and T so that the subroutine starting at line 3000 can be called to plot the triangle. The outer loop, controlled by K, ensures that all the triangles are dealt with.

The triangle-plotting routine simply calls our much used line-drawing subroutine (which begins at line 2000) three times. The line drawing routine draws a line from (X1, Y1) to (X2, Y2) and this gives the triangle-plotting routine as:

```
3000 X1=S(3), Y1=T(3
3010 FOR P=1 TO 3
3020 X2=S,P) Y2=T(P)
3030 GOSUB 2000· REM DRAW LINE
3040 X1=X2· Y1=Y2
3050 NEXT P
3060 RETURN
```

Apart from the previously-used routines, this gives the complete program for creating the regular triangular mesh. It is now a simple matter to perturb the points at the corners of the triangles randomly before the triangles are plotted, so that we get our mountain. The perturbing can be done in the innermost subroutine, the one starting at line 5000, by adding to the co-ordinates a random amount with a variation that is proportional to the length of the side being bisected. For simplicity, the perturbation has been taken as a random amount between +/- 0.1*(length of the line in the x-direction). This gives the amended subroutine as

```
5000 A1=(S(1)-S(2))*0.2*(RND(0)-0 5
5010 B1=(S(1)-S(3))*0.2* RND(0)-0.5)
5020 C1=(S(2)-S(3))*0.2*(RND(0) 0 5
5030 A=0.5*(S(1)+S(2)) + A1
5040 D=0 5*(R(1)+T(2)) + A1
5050 B=0.5*(S(1)+S(3)) +B1
5060 E=0.5*(R(1)+T(3)) + B1
5070 C=0.5*(S(2)+S(3)) + C1
5080 F=0.5*(T(2)+T(3)) + C1
5090 U(1)=S(1): U(4)=S(2)· U(7)=S(3)
5100 V(1)=T(1): V 4)=T(2). V 7 T(3)
5110 U 2 =A U(6)=A U(12 =A
5120 V(2) D V 6 D V 12 D
5130 U 3=B U 8 =B U 11 =B
5140 V(3)=E V 8 E V 11 E
5150 U(5)=C: U(9)=C U(10)=C
5160 V(5)=F· V(9)=· V(10)=F
5170 RETURN
```

The complete listing of the program to create the artificial landscape is given as Figure 5.

Further developments

The program can be extended to take the sub-division process further, so producing a more detailed landscape. The program only needs a few numerical changes for this which follow at once from the number of triangles there will be in the new arrangement. Don't forget to change the dimensions of the arrays! The way that the randomness is introduced can be made much more general, and the constant of proportionately for the range of the perturbations can be changed. You may like to experiment with this to see if you can characterise the differences between the types of landscapes that are produced by significantly different values for the constant of porportionality. Remember that because the perturbations are random, each rub of a program gives a different picture, although one that belongs to the same family

IN CHARACTER

If you want to design your own games or use high-resolution and multi-colour characters, then this program by John McHale could be just what you're looking for.

Setting up

TYPE IN THE LISTING PROVIdded and save it on a disk or tape before attempting to run it

Now RUN it and if all has gone smoothly, you will be given the option of saving the 4K Machine Code File to the device of your preference

You should make it a habit, to 'verify' all programs that you save so as not to end up being disappointed, if you are not able to reload the program It would also be a good idea to make a second copy, just in case you 'scratch' the first by accident

For those of you who are not fortunate enough to enter the data correctly first time you will be given one of two possible error reports (or maybe both)

These two error reports are as follows:

1 Insufficient/Too Many Data Items Error
2 Checksum Error

If you get error 1, then you will almost certainly get error 2 as well If you get error 2 on its own, then you have entered some of the Data Items incorrectly e g you may have entered 250 instead of 240 Error 1 is self explanatory

It would be useful to have a friend close by, to read out the data statements to you, in order to minimise the risk of errors

Using the Program

Load the code by typing –

Load " ",1,1 or Lad "GEN'64.",1,1 for the tape version
Load "GEN'64.",8,1 for the disk version

Now type 'SYS 64738' to cold start the machine before using the program. Type 'SYS 52882' to enter the Characater Generator

The Program resides at $C000 (49152 decimal) which is well out of the reach of Basic.

The user has the ability, using this versatile utility, to write a Basic program of up to 10K and at the same time, being able to enter and exit the Character Generator at will

It is important to note that the data for your user defined graphics, resides in a 2K block – ($3000-$37FF) or 12288 to 14335 decimal and the complete set may be accessed by typing 'POKE 53272,28'.

Users who delight in designing games, using high-resolution and multi-colour characters, will find this program an invaluable aid for their graphics. A maximum of 256 Characters (which is more than enough) may be redefined. I have allocated these 256 Characters into four Subsets of 64 Characters each

Alert users will notice, that when you enter the Character Generator for the first time, the standard PET character set is loaded into the user definable area, but this only happens once

Try this exercise Switch off the Machine. Load in the Character Generator. Type 'SYS 64738' and POKE 53272. You will not note that all the characters have turned to garbage. Type SYS 52882 and press 'Q' for quit. You should be back in Basic at this stage Now type POKE 53272,28 Notice that the PET character set has now been loaded down Type POKE 12288,255 and press ' ' and you will notice a straight line going across the top of the

Character Generator — User Function List

Function	Name	Keypress(es)
01	cursor home	'Clr/Home
02	clear grid	Shift + 'Clr/Home'
03	cursor right	'Csrs l/r'
04	cursor left	Shift+'Crsr l/r'
05	cursor down	'Crsr u/d'
06	cursor up	Shift+ 'Crsr u/d'
07	fill	
08	delete	'Del'
09	space	'Spc'
10	new line	Ret'
11	quick fill	F'
12	quick rub	D'
13	enable wrap mode	'W'
14	disable wrap mode	'W
15	select character	
16.	set+	+'
17	set-	- ,
18	next char	
19	ast char	*'
20	enable multicolour	'M
21	disable multicolour	'M
22	speed cursor	'.'
23	slow cursor	
24	update cursor colour	
25.	update multicolour 1	1'
26.	update multicolour 2	2' ,
27	update screen Colour	
28	shift right	F7'
29	shift left	F5'
30	shift down	F3
31	shift up	F1
32	90° Rotate	'A or 'C
33	invert character	I
34	180° rotate	R
35	transfer character	'T'
36.	transfer set	CTRL+'T'
37	reverse video	'9
38	recal	'E
39	load characters	L
40.	save characters	'S'
41	quit	Q'

' ' sign. Now type SYS 52882 and you will notice that this character has not been changed.

The Program uses a very powerful Raster Interrupt, to enable the CBM set and the user defined graphics to be displayed at the same time. Their routine also handles such effects as split screen colour etc.

Reading the next section should convince you of the value of this extremely powerful Character Generator.

Select

When you first use the Character Generator, you will notice four lines to the right of the grid, which generate status reports. The most significant of these is the first, i.e. Character Mode. On running the program, this is set to 'Edit', which is the default mode. In this mode, you are able to access all of the listed functions. However, if you press ' ', then the character mode will change to select.

Immediately, you will see that the cursor is no longer on the grid, but is now flashing on a line of characters which are directly below the grid. The only keys valid in this mode are Shift, Crsr l/r, ' 'E'.

Use the Crsr l/r key in the normal way (in conjunction with the Shift key) to locate the character you wish to edit. Now press 'E' and the character mode will return to Edit and you will be able to experiment with the character you have selected.

Alternatively, as mentioned in the Function List, you may use functions 18 and 19 (Next Char & Last Char) to achieve the same result without ever having to enter the Select Mode.

Transfer Set

To transfer a set of 64 characters to another location, first press CTRL & 'T'. You should now see the Character Set no. (fourth status line) flashing.

Using the functions 'Set +' and 'Set -', choose the set that you want the original to be transferred to.

Now press 'Return', the transfer will be completed and normal operation restored.

Recall

Have you ever made a complete mess of a sprite or UDG that you were designing and wished you could restore it to its original form. This is what 'Recall' is for.

Every character you use is automatically 'buffered' so that in the event of you using the functions excessively, pressing 'Recall' will restore the character to its original form.

A Finishing Note

Do not try to define your first blockbusting character set immediately. Mess around with the various functions, until you become familiar with them. I hope you enjoy using it.

Description

Positions cursor in top left of grid
As above and clears current character
Moves cursor right one space
Moves cursor left one space
Moves cursor down one space
Moves cursor up one space
Fills space at current cursor location.
Deletes space to left of cursor
Rubs space to right of cursor
Places cursor on left of next line down
Fills left-right on current line
Deletes left-right on current line
Allows code to move off the edge of the grid and appear on the opposite side
Keeps cursor within grid boundaries
Enables user to select the next character to be edited.
Advances to next subset of 64 chars
Returns to previous subset
Allows the user to move to the next character without having to enter 'Select Mode' – see notes on 15.
As above but moves backwards rather than forwards.
Enables character multicolour mode
Disables character multicolour mode
Speeds cursor's response.
Slows cursor response
Self explanatory
Self explanatory
Self explanatory
Self explanatory (Split screen colour)
Moves complete character right (1 Bit)
Moves complete character left (1 bit)
Moves complete character down (1 bit)
Moves complete character up (1 bit)
Rotate character through 90 degrees 'A' anticlockwise 'C' clockwise
Flips character upside down
Creates Mirror image of character through the vertical axis (Works in hi/res & multicolour modes)
Copies one character in the current set into another character in the same set.
Transfers one complete set to another
'9'=Rvs Char: Ctrl+'9' = Rvs Set
Recalls 'buffered' character (See special notes on this function)
Load character sets from tape or disk
Saves character sets to tape or disk (note, pressing 'S' will save the current subset (64 chars.), pressing 'Ctrl'+'S' will save the entire four sets
Exit to Basic

Program Listing

```
0 REM
1 REM                                  :
2 REM    CHARACTER GENERATOR           :
3 REM
4 REM    4K PURE M/CODE                :
5 REM
6 REM    OVER 40 FUNCTIONS.
7 REM
8 REM    WRITTEN BY J.MC HALE
9 REM
10 REM   SIRANDHILL RD.,SLIGO,
11 REM                                 :
12 REM   REP. IRELAND.                 :
13 REM
14 REM   DEDICATED TO:                 :
15 REM
16 REM   JENNIFER ..........
17 REM
18 REM                                 :
```

Program Listing (cont.)

```
20 PRINT"[CLEAR]":REM CLR/HOME
30 POKES3281,0:POKES3280,0
40 PRINT"[YELLOW]PLEASE WAIT, WRIT
ING CODE TO MEMORY ."
50 SA=49152:BC=0:TL=0
60 READA:IFA=-1THEN80
70 POKESA+BC,A.BC=BC+1:TL=TL+A:GOT
O60
80 REM * ERROR TRAPPING *
90 IFBC<>3882THEN400
100 IFTL<>483826THEN400
110 POKES3280,14:POKES3281,6:PRINT
"[CLEAR][c 7]":REM CLR/HOME & LIGH
T BLUE ( CTR
L+'7')
120 PRINT"[DOWN]OKAY - CODE ENTERE
D CORRECTLY ."
130 PRINT"[DOWN]YOU MAY NOW SAVE T
HE PROGRAM CODE TO     "
140 PRINT"EITHER TAPE OR DISK."
150 DV=1
160 INPUT"[DOWN]WHICH DEVICE ( T O
R D ) : ";D$
170 IFD$<>"D"ANDD$<>"T"THEN160
180 IFD$="D"THENDV=8
190 IFDV=8THEN220
200 PRINT"[DOWN]PLACE [RVSON]BLANK
[RVSOFF] CASSETTE IN C2N UNIT, REW
IND"
210 PRINT"AND PRESS STOP/EJECT." G
OTO230
220 PRINT"PLACE [RVSON]FORMATTEDCR
VSOFF] DISK IN DRIVE#0 (DEV 8)."
230 PRINT"[DOWN][DOWN]PRESS '*' WH
EN READY .[DOWN][DOWN]"
240 POKE198,0
250 GETA$:IFA$<>"*"THEN250
260 POKE198,0:POKE2,DV.SYS52992
300 PRINT"[DOWN]PLEASE VERIFY CODE
 BY TYPING :"
310 PRINT"[DOWN]TAPE VERSION - 'VE
RIFY"CHR$(34)CHR$(34  ,1,1'"
320 PRINT"[DOWN]DISK VERSION - 'VE
RIFY"CHR$(34)"GEN'64."CHR$(34)",8,
1'"
330 PRINT"[DOWN]THIS IS A PRECAUTI
ONARY MEASURE TO MAKE "
340 PRINT"SURE THAT THE CODE HAS B
EEN SAVED        "
350 PRINT" CORRECTLY."
360 END
400 REM * ANALYSE ERRORS AND REPOR
T *
410 IFTL<>483826THENPRINT"[DOWN]CH
ECKSUM ERROR."
420 IFBC=3882THEN460
430 IFBC<3882THENPRINT"[DOWN]INSUF
FICIENT ";:GOTO450
440 PRINT"[DOWN]TOO MANY ";
450 PRINT"DATA ITEMS."
460 PRINT"[DOWN][DOWN]CHECK DATA S
TATEMENTS CAREFULLY.":STOP
1000 DATA  160, 151, 146, 137, 148
, 148, 133, 142, 160, 130
1010 DATA  153, 160, 160, 186, 160
, 160, 138, 143, 136, 142
1020 DATA  160, 141, 131, 160, 136
, 129, 140, 133, 174, 160
1030 DATA  168, 131, 169, 160, 160
, 147, 133, 144  148, 133
1040 DATA  141, 130, 133, 146, 160
, 160, 177, 185, 184, 180
1050 DATA  160, 174, 160, 160, 160
, 160, 160, 160, 131, 136
1060 DATA  129, 146, 129, 131, 148
, 133, 146, 160, 141, 143
1070 DATA  132, 133, 160, 186, 141
, 173, 131, 143, 140, 143
1080 DATA  149, 146, 160, 160, 141
, 143, 132, 133, 160, 186
1090 DATA  131, 136, 129, 146, 129
, 131, 148, 133, 146, 160
1100 DATA  160, 147, 133, 148, 160
, 186, 133, 132, 137, 148
1110 DATA  160, 160, 147, 133, 140
, 133, 131, 148, 143, 134
1120 DATA  134, 143, 142, 160, 169
, 147, 32, 210, 255, 169
1130 DATA  6, 141, 33, 208, 73, 8,
 141, 32, 208, 162
1140 DATA  40, 169, 160, 157, 87,
6, 169, 7, 157, 87
1150 DATA  218, 202, 208, 243, 189
, 0, 192, 157, 11, 4
1160 DATA  189, 29, 192, 157, 91,
4, 169, 1, 157, 11
1170 DATA  216, 169, 3, 157, 91, 2
```

Program Listing (cont.)

```
16, 169, 160, 157, 171
1180 DATA  4, 157, 211, 4, 157, 25
1, 4, 157, 35, 5
1190 DATA  157, 75, 5, 157, 171, 2
16, 73, 1, 157, 75
1200 DATA  217, 157, 211, 216, 157
, 251, 216, 157, 35, 217
1210 DATA  232, 224, 29, 208, 195,
 169, 0, 133, 251, 133
1220 DATA  253, 170, 169, 4, 133,
252, 169, 216, 133, 254
1230 DATA  160, 0, 169, 160, 145,
251, 169, 4, 145, 253
1240 DATA  200, 192, 11, 208, 243,
 165, 251, 24, 105, 40
1250 DATA  133, 251, 133, 253, 165
  252, 105, 0, 133, 252
1260 DATA  105, 212, 133, 254, 232
  224, 11, 208, 217, 169
1270 DATA  72, 133, 251, 169, 4, 1
33, 252, 162, 176, 160
1280 DATA  9, 138, 145, 251, 153,
40, 4, 165, 251, 24
1290 DATA  105, 41, 133, 251, 165,
 252, 105, 0, 133, 252
1300 DATA  136, 232, 224, 184, 208
, 231, 162, 0, 189, 58
1310 DATA  192, 157, 211, 4, 189,
74, 192, 157, 251, 4
1320 DATA  189, 198, 193, 157, 35,
 5, 232, 224, 16, 208 .
1330 DATA  233, 96, 120, 173, 14,
220, 41, 254, 141, 14
1340 DATA  220, 173, 17, 208, 41,
127, 141, 17, 208, 169
1350 DATA  132, 141, 20, 3, 169, 1
93, 141, 21, 3, 169
1360 DATA  177, 141, 18, 208, 173,
 26, 208, 9, 1, 141
1370 DATA  26, 208, 88, 96, 173, 2
5, 208, 9, 1, 141
1380 DATA  25, 208, 104, 168, 104,
 170, 104, 64, 169, 1
1390 DATA  44, 25, 208, 240, 243,
173, 24, 208, 41, 8
1400 DATA  208, 40, 160, 28, 174,
18, 207, 169, 49, 141
1410 DATA  18, 208, 173, 14, 207,
208, 8, 173, 22, 208
1420 DATA  41, 239, 76, 174, 193,
173, 22, 208, 9, 16
1430 DATA  141, 22, 208, 142, 33,
208, 140, 24, 208, 76
1440 DATA  118, 193, 162, 6, 160,
20, 169, 177, 141, 18
1450 DATA  208, 76, 161, 193, 151,
 146, 129, 144, 129, 146
1460 DATA  143, 149, 142, 132, 160
, 160, 160, 160, 160, 186
1470 DATA  133, 142, 129, 130, 140
, 133, 132, 160, 132, 137
1480 DATA  147, 129, 130, 140, 133
, 132, 120, 169, 49, 141
1490 DATA  20, 3, 169, 234, 141, 2
1, 3, 173, 14, 220
1500 DATA  9, 1, 141, 14, 220, 88,
 96, 0, 0, 0
1510 DATA  173, 14, 220, 41, 254,
141, 14, 220, 165, 1
1520 DATA  41, 251, 133, 1, 169, 0
, 133, 251, 133, 253
1530 DATA  169, 208, 133, 252, 169
, 48, 133, 254, 162, 0
1540 DATA  160, 0, 177, 251, 145,
253, 200, 208, 249, 230
1550 DATA  252, 230, 254, 232, 224
, 8, 208, 238, 165, 1
1560 DATA  9, 4, 133, 1, 173, 14,
220, 9, 1, 141
1570 DATA  14, 220, 234, 96, 169,
0, 133, 254, 162, 8
1580 DATA  10, 38, 254, 6, 252, 14
4, 7, 24, 101, 251
1590 DATA  144, 2, 230, 254, 202,
208, 239, 133, 253, 96
1600 DATA  173, 12, 207, 133, 251,
 169, 8, 133, 252, 32
1610 DATA  62, 194, 165, 254, 24,
105, 48, 133, 254, 169
1620 DATA  82, 133, 249, 133, 251,
 169, 4, 133, 250, 169
1630 DATA  216, 133, 252, 160, 0,
177, 253, 170, 152, 72
1640 DATA  138, 162, 8, 160, 0, 10
, 72, 144, 8, 169
1650 DATA  81, 145, 249, 145, 251,
 208, 8, 169, 43, 145
1660 DATA  249, 169, 0, 145, 251,
104, 200, 202, 208, 231
1670 DATA  165, 249, 24, 105, 40,
133, 249, 133, 251, 165
1680 DATA  250, 105, 0, 133, 250,
105, 212, 133, 252, 104
1690 DATA  168, 200, 192, 8, 208,
195, 234, 96, 169, 64
1700 DATA  133, 251, 173, 13, 207,
```

```
 133, 252, 32, 62, 194
1710 DATA  162, 0, 160, 4, 169, 1,
 153, 224, 217, 153
1720 DATA  8, 218, 138, 24, 101, 2
53, 153, 224, 5, 24
1730 DATA  105, 32, 153, 8, 6, 232
, 200, 192, 36, 208
1740 DATA  229, 169, 188, 133, 248
, 133, 250, 169, 6, 133
1750 DATA  249, 169, 218, 133, 251
, 169, 0, 133, 2, 162
1760 DATA  0, 160, 0, 138, 24, 101
, 253, 145, 248, 173
1770 DATA  19, 207, 72, 173, 14, 2
07, 240, 5, 104, 9
1780 DATA  8, 208, 1, 104, 145, 25
0, 232, 200, 192, 16
1790 DATA  208, 227, 165, 248, 24,
 105, 80, 133, 248, 133
1800 DATA  250, 165, 249, 105, 0,
133, 249, 105, 212, 133
1810 DATA  251, 230, 2, 165, 2, 20
1, 4, 208, 198, 96
1820 DATA  169, 169, 133, 250, 133
, 252, 169, 6, 133, 251
1830 DATA  169, 218, 133, 253, 169
, 0, 133, 2, 170, 160
1840 DATA  0, 173, 12, 207, 145, 2
50, 138, 145, 252, 232
1850 DATA  200, 200, 192, 8, 208,
241, 165, 250, 24, 105
1860 DATA  80, 133, 250, 133, 252,
 165, 251, 105, 0, 133
1870 DATA  251, 105, 212, 133, 253
, 230, 2, 165, 2, 201
1880 DATA  4, 208, 212, 96, 173, 4
, 207, 133, 250, 173
1890 DATA  5, 207, 133, 251, 172,
7, 207, 177, 250, 41
1900 DATA  63, 141, 12, 207, 169,
64, 133, 251, 173, 13
1910 DATA  207, 133, 252, 32, 62,
194, 173, 12, 207, 24
1920 DATA  101, 253, 141, 12, 207,
 96, 173, 8, 207, 133
1930 DATA  250, 173, 9, 207, 133,
251, 172, 10, 207, 96
1940 DATA  32, 158, 195, 160, 0, 1
69, 0, 133, 2, 177
1950 DATA  250, 72, 74, 74, 74, 74
, 74, 74, 24, 101
1960 DATA  2, 133, 2, 104, 72, 10,
 10, 10, 10, 10
1970 DATA  10, 24, 101, 2, 133, 2,
 104, 72, 41, 48
1980 DATA  74, 74, 24, 101, 2, 133
, 2, 104, 41, 12
1990 DATA  10, 10, 24, 101, 2, 145
, 250, 200, 192, 8
2000 DATA  208, 199, 96, 32, 158,
195, 160, 0, 169, 0
2010 DATA  133, 2, 162, 8, 177, 25
0, 10, 72, 144, 9
2020 DATA  165, 2, 74, 9, 128, 133
, 2, 208, 2, 70
2030 DATA  2, 104, 202, 208, 237,
165, 2, 145, 250, 200
2040 DATA  192, 8, 208, 220, 96, 3
2, 158, 195, 169, 7
2050 DATA  133, 2, 160, 0, 152, 72
, 177, 250, 170, 164
2060 DATA  2, 177, 250, 72, 138, 1
45, 250, 104, 170, 104
2070 DATA  168, 138, 145, 250, 198
, 2, 200, 192, 4, 208
2080 DATA  229, 96, 152, 72, 177,
250, 164, 2, 145, 250
2090 DATA  104, 168, 96, 32, 158,
195, 169, 7, 133, 2
2100 DATA  160, 6, 32, 58, 196, 16
9, 0, 145, 250, 198
2110 DATA  2, 136, 192, 255, 208,
242, 96, 32, 158, 195
2120 DATA  162, 0, 134, 2, 160, 1,
 32, 58, 196, 230
2130 DATA  2, 200, 192, 8, 208, 24
6, 136, 138, 145, 250
2140 DATA  96, 32, 158, 195, 160,
0, 177, 250, 10, 145
2150 DATA  250, 200, 192, 8, 208,
246, 96, 32, 158, 195
2160 DATA  169, 128, 133, 2, 160,
8, 169,, 0, 153, 247
2170 DATA  207, 136, 208, 250, 152
, 72, 177, 250, 160, 0
2180 DATA  74, 144, 10, 72, 185, 2
48, 207, 5, 2, 153
2190 DATA  248, 207, 104, 200, 192
, 8, 208, 238, 70, 2
2200 DATA  104, 168, 200, 192, 8,
208, 223, 160, 0, 185
2210 DATA  248, 207, 145, 250, 200
, 192, 8, 208, 246, 96
2220 DATA  238, 18, 207, 96, 238,
34, 208, 96, 238, 35
2230 DATA  208, 96, 238, 39, 208,
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Program Listing (cont.)

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96, 238, 19, 207, 96
2240 DATA  173, 17, 207, 56, 233,
1, 208, 1, 96, 141
2250 DATA  17, 207, 96, 173, 17, 2
07, 24, 105, 1, 144
2260 DATA  244, 96, 173, 14, 207,
73, 1, 141, 14, 207
2270 DATA  32, 101, 199, 96, 172,
3, 207, 136, 208, 21
2280 DATA  173, 23, 207, 240, 15,
169, 1, 141, 11, 207
2290 DATA  169, 96, 141, 0, 208, 1
69, 8, 141, 3, 207
2300 DATA  96, 140, 3, 207, 14, 11
, 207, 173, 0, 208
2310 DATA  56, 233, 8, 141, 0, 208
  96, 172, 3, 207
2320 DATA  200, 192, 9, 208, 21, 1
73, 23, 207, 240, 15
2330 DATA  169, 128, 141, 11, 207,
 169, 40, 141, 0, 208
2340 DATA  169, 1, 141, 3, 207, 96
, 140, 3, 207, 78
2350 DATA  11, 207, 173, 0, 208, 2
4, 105, 8, 141, 0
2360 DATA  208, 96, 174, 2, 207, 2
02, 208, 30, 173, 23
2370 DATA  207, 240, 24, 169, 105,
 141, 0, 207, 169, 5
2380 DATA  141, 1, 207, 162, 8, 14
2, 2, 207, 202, 142
2390 DATA  10, 207, 169, 122, 141,
 1, 208, 96, 142, 2
2400 DATA  207, 206, 10, 207, 173,
 0, 207, 56, 233, 40
2410 DATA  141, 0, 207, 173, 1, 20
7, 233, 0, 141, 1
2420 DATA  207, 173, 1, 208, 56, 2
33, 8, 141, 1, 208
2430 DATA  96, 174, 2, 207, 232, 2
24, 9, 208, 30, 173
2440 DATA  23, 207, 240, 24, 169,
81, 141, 0, 207, 169
2450 DATA  4, 141, 1, 207, 162, 1,
 142, 2, 207, 202
2460 DATA  142, 10, 207, 169, 66,
141, 1, 208, 96, 142
2470 DATA  2, 207, 238, 10, 207, 1
73, 0, 207, 24, 105
2480 DATA  40, 141, 0, 207, 173, 1
, 207, 105, 0, 141
2490 DATA  1, 207, 173, 1, 208, 24
, 105, 8, 141, 1
2500 DATA  208, 96, 173, 141, 2, 4
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2510 DATA  37, 197, 96, 32, 250, 1
96, 96, 173, 141, 2
2520 DATA  41, 1, 208, 4, 32, 151,
 197, 96, 32, 82
2530 DATA  197, 96, 162, 63, 169,
0, 157, 64, 3, 202
2540 DATA  208, 250, 73, 255, 157,
 64, 3, 232, 232, 232
2550 DATA  224, 24, 208, 246, 96,
169, 128, 162, 74, 160
2560 DATA  70, 141, 137, 196, 142,
 156, 196, 140, 174, 196
2570 DATA  32, 133, 196, 96, 169,
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2580 DATA  76, 25, 198, 173, 0, 20
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2590 DATA  207, 133, 251, 172, 3,
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2600 DATA  160, 0, 177, 250, 73, 2
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2610 DATA  8, 208, 245, 96, 169, 0
, 133, 250, 173, 13
2620 DATA  207, 10, 24, 105, 48, 1
33, 251, 162, 0, 160
2630 DATA  0, 177, 250, 73, 255, 1
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2640 DATA  230, 251, 232, 224, 2,
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2650 DATA  2, 41, 4, 208, 4, 32, 6
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2660 DATA  78, 198, 96, 173, 21, 2
08, 73, 1, 141, 21
2670 DATA  208, 96, 173, 21, 208,
73, 2, 141, 21, 208
2680 DATA  96, 169, 10, 141, 124,
196, 32, 117, 196, 96
2690 DATA  169, 74, 208, 245, 32,
212, 196, 76, 186, 194
2700 DATA  173, 4, 207, 133, 250,
173, 5, 207, 133, 251
2710 DATA  172, 7, 207, 96, 32, 15
8, 195, 169, 0, 145
2720 DATA  250, 96, 32, 158, 195,
169, 255, 145, 250, 96
2730 DATA  173, 14, 207, 208, 4, 3
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2740 DATA  172, 195, 96, 169, 66,
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2760 DATA  141, 1, 207, 162, 1,
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2770 DATA  207, 202, 142, 10, 207,
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, 1, 96, 32, 158
2790 DATA  195, 169, 0, 145, 250,
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2800 DATA  96, 162, 0, 189, 90, 19
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2810 DATA  224, 16, 208, 245, 96,
173, 13, 207, 24, 105
2820 DATA  176, 141, 92, 5, 162, 0
, 173, 15, 207, 208
2830 DATA  5, 189, 106, 192, 208,
3, 189, 112, 192, 157
2840 DATA  228, 4, 232, 224, 6, 20
8, 235, 173, 23, 207
2850 DATA  208, 5, 189, 216, 193,
208, 3, 189, 208, 193
2860 DATA  157, 46, 5, 232, 224, 1
4, 208, 235, 173, 14
2870 DATA  207, 208, 5, 189, 104,
192, 208, 3, 189, 107
2880 DATA  192, 157, 254, 4, 232,
224, 17, 208, 235, 32
2890 DATA  9, 199, 96, 32, 23, 199
, 206, 19, 207, 32
2900 DATA  158, 198, 96, 173, 23,
207, 73, 1, 141, 23
2910 DATA  207, 32, 23, 199, 96, 1
73, 12, 207, 133, 251
2920 DATA  169, 8, 133, 252, 32, 6
2, 194, 165, 253, 141
2930 DATA  8, 207, 165, 254, 24, 1
05, 48, 141, 9, 207
2940 DATA  96, 32, 186, 194, 32, 2
3, 199, 32, 116, 195
2950 DATA  32, 123, 199, 32, 88, 1
94, 32, 52, 195, 96
2960 DATA  173, 13, 207, 24, 105,
1, 201, 4, 208, 1
2970 DATA  96, 141, 13, 207, 76, 5
3, 202, 173, 13, 207
2980 DATA  56, 233, 1, 201, 255, 2
08, 240, 96, 173, 21
2990 DATA  208, 41, 1, 141, 21, 20
8, 96, 173, 21, 208
3000 DATA  9, 2, 141, 21, 208, 96,
 172, 7, 207, 200
3010 DATA  192, 33, 208, 90, 174,
6, 207, 232, 224, 3
3020 DATA  208, 46, 173, 23, 207,
208, 1, 96, 32, 196
3030 DATA  199, 169, 227, 141, 4,
207, 169, 5, 141, 5
3040 DATA  207, 169, 146, 141, 3,
208, 169, 1, 141, 6
3050 DATA  207, 141, 7, 207, 169,
56, 141, 2, 208, 169
3060 DATA  0, 141, 16, 208, 32, 20
5, 199, 96, 142, 6
3070 DATA  207, 32, 196, 199, 173,
 4, 207, 24, 105, 40
3080 DATA  141, 4, 207, 173, 5, 20
7, 105, 0, 141, 5
3090 DATA  207, 173, 3, 208, 24, 1
05, 8, 141, 3, 208
3100 DATA  169, 1, 208, 203, 140,
7, 207, 173, 2, 208
3110 DATA  24, 105, 8, 72, 144, 8,
 173, 16, 208, 9
3120 DATA  2, 141, 16, 208, 104, 1
41, 2, 208, 96, 172
3130 DATA  7, 207, 136, 208, 88, 1
74, 6, 207, 202, 208
3140 DATA  48, 173, 23, 207, 208,
1, 96, 32, 196, 199
3150 DATA  169, 11, 141, 4, 207, 1
69, 6, 141, 5, 207
3160 DATA  169, 154, 141, 3, 208,
169, 2, 141, 6, 207
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69, 48, 141, 2, 208
3180 DATA  169, 2, 141, 16, 208, 3
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, 207, 233, 0, 141
3210 DATA  5, 207, 173, 3, 208, 56
, 233, 8, 141, 3
3220 DATA  208, 208, 203, 140, 7,
207, 173, 2, 208, 56
3230 DATA  233, 8, 72, 176, 5, 169
, 0, 141, 16, 208
3240 DATA  104, 141, 2, 208, 96, 1
69, 1, 141, 15, 207
3250 DATA  32, 23, 199, 32, 159, 2
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3260 DATA  208, 28, 173, 141, 2, 4
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3270 DATA  214, 199, 76, 230, 200,
 32, 81, 200, 32, 2
3280 DATA  201, 32, 136, 198, 32,
155, 199, 76, 205, 200
3290 DATA  201, 14, 208, 240, 169,
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Program Listing (cont.)

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3300 DATA  23, 199, 32, 14, 201, 9
6, 172, 17, 207, 162
3310 DATA  0, 202, 208, 253, 136,
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3320 DATA  195, 160, 0, 177, 250,
153, 240, 207, 200, 192
3330 DATA  8, 208, 246, 96, 32, 15
8, 195, 160, 0, 185
3340 DATA  240, 207, 145, 250, 200
, 192, 8, 208, 246, 96
3350 DATA  32, 214, 199, 76, 47, 2
02, 32, 81, 200, 76
3360 DATA  47, 202, 32, 158, 195,
173, 11, 207, 73, 255
3370 DATA  49, 250, 145, 250, 96,
32, 158, 195, 177, 250
3380 DATA  13, 11, 207, 145, 250,
32, 37, 197, 76, 88
3390 DATA  194, 32, 250, 196, 32,
58, 201, 76, 88, 194
3400 DATA  32, 58, 201, 32, 37, 19
7, 76, 88, 194, 32
3410 DATA  50, 197, 76, 151, 197,
0, 51, 2, 7, 60
3420 DATA  44, 0, 1, 21, 18, 50, 4
5, 53, 48, 46
3430 DATA  49, 54, 40  43  17, 33
 10, 20, 6, 3
3440 DATA  4, 5, 32, 57, 36, 56, 5
9, 8, 9, 62
3450 DATA  42, 13, 22,"0, 0, 0, 20
7, 222, 237, 96
3460 DATA  71, 87, 105, 186, 178,
216, 229, 208, 30, 104
3470 DATA  52, 46, 168, 185, 194,
21, 19, 38, 145, 154
3480 DATA  93, 69, 112, 196, 238,
200, 204, 158, 111, 170
3490 DATA  58, 25, 91, 0, 0, 0, 19
8, 197, 197, 201
3500 DATA  201, 201, 201, 198, 198
, 196, 196, 196, 201, 205
3510 DATA  201, 201, 199, 199, 198
, 196, 198, 198, 198, 198
3520 DATA  196, 196, 198, 196, 196
, 196, 196, 198, 199, 202
3530 DATA  206, 206, 205, 0, 0, 0,
 32, 159, 255, 162
3540 DATA  0, 165, 197, 221, 112,
201, 208, 15, 189, 152
3550 DATA  201, 141, 46, 3, 189, 1
92  201, 141, 47, 3
3560 DATA  108, 46, 3, 232, 224, 3
7, 208, 231, 96, 81
3570 DATA  4, 1, 1, 227, 5, 1, 1,
0, 48, 0
3580 DATA  128, 0, 0, 0, 0, 1, 40,
 10, 0, 0
3590 DATA  1, 0, 1, 162, 0, 189, 9
, 202, 157, 0
3600 DATA  207, 232, 224, 24, 208,
 245, 96, 32, 155, 199
3610 DATA  76, 14, 201, 32, 149, 1
99, 76, 14, 201, 169
3620 DATA  0, 32, 210, 255, 162, 0
, 32, 207, 255, 201
3630 DATA  13, 240, 10, 157, 32, 2
07, 232, 224, 16, 208
3640 DATA  241, 169, 13, 142, 22,
207, 32, 210, 255, 96
3650 DATA  169, 0, 141, 26, 208, 1
41, 21, 208, 169, 6
3660 DATA  141, 33, 208, 73, 8, 14
1, 32, 208, 169, 147
3670 DATA  32, 210, 255, 96, 169,
28, 141, 24, 208, 162
3680 DATA  0, 138, 157, 0, 4, 169,
 1, 157, 0, 216
3690 DATA  232, 208, 244, 162, 0,
189, 149, 202, 32, 210
3700 DATA  255, 232, 224, 21, 208,
 245, 108, 2, 3, 17
3710 DATA  17, 17, 17, 17, 17, 17,
 13, 81, 85, 73
3720 DATA  84, 46, 13, 82, 69, 65,
 68, 89, 46, 13
3730 DATA  32, 90, 202, 76, 125, 2
05, 12, 15, 1, 4
3740 DATA  46, 19, 1, 22, 5, 46, 1
73, 14, 220, 41
3750 DATA  254, 141, 14, 220, 165,
 1, 41, 251, 133, 1
3760 DATA  169, 48, 133, 247, 169,
 207, 133, 248, 162, 0
3770 DATA  138, 72, 189, 176, 202,
 133, 251, 169, 8, 133
3780 DATA  252, 234, 32, 62, 194,
165, 254, 24, 105, 208
3790 DATA  133, 254, 160, 0, 177,
253, 145, 247, 200, 192
3800 DATA  8, 208, 247, 165, 247,
24, 105, 8, 133, 247
3810 DATA  165, 248, 105, 0, 133,
248, 104, 170, 232, 224
3820 DATA  10, 208, 203, 165, 1, 9
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3830 DATA  14, 220, 9, 1, 141, 14,
 220, 96, 173, 13
3840 DATA  207, 133, 255, 32, 159,
 255, 165, 197, 201, 1
3850 DATA  240, 31, 201, 40, 208,
6, 32, 168, 199, 76
3860 DATA  53, 203, 201, 43, 208,
3, 32, 185, 199, 173
3870 DATA  92, 5, 73, 128, 141, 92
, 5, 32, 2, 201
3880 DATA  76, 27, 203, 173, 13, 2
07, 10, 24, 105, 48
3890 DATA  133, 253, 169, 0, 133,
250, 133, 252, 165, 255
3900 DATA  10, 24, 105, 48, 133, 2
51, 162, 0, 160, 0
3910 DATA  177, 250, 145, 252, 200
, 208, 249, 230, 251, 230
3920 DATA  253, 232, 224, 2, 208,
238, 165, 255, 141, 13
3930 DATA  207, 173, 92, 5, 9, 128
, 141, 92, 5, 76
3940 DATA  53, 202, 169, 80, 133,
247, 133, 249, 133, 251
3950 DATA  169, 4, 133, 248, 133,
250, 162, 0, 138, 72
3960 DATA  160, 0, 152, 72, 177, 2
53, 160, 0, 10, 144
3970 DATA  17, 72, 169, 160, 145,
249, 165, 250, 24, 105
3980 DATA  212, 133, 252, 169, 1,
145, 251, 104, 200, 192
3990 DATA  8, 208, 231, 165, 249,
24, 105, 40, 133, 249
4000 DATA  133, 251, 165, 250, 105
, 0, 133, 250, 104, 168
4010 DATA  200, 192, 8, 208, 203,
165, 247, 24, 105, 8
4020 DATA  133, 247, 133, 249, 133
, 251, 165, 248, 105, 0
4030 DATA  133, 248, 133, 250, 165
, 253, 24, 105, 8, 133
4040 DATA  253, 165, 254, 105, 0,
133, 254, 104, 170, 232
4050 DATA  224, 5, 208, 160, 96, 1
69, 207, 133, 254, 173
4060 DATA  20, 207, 208, 4, 169, 4
8, 208, 2, 169, 88
4070 DATA  133, 253, 76, 126, 203,
 169, 0, 133, 250, 133
4080 DATA  252, 165, 170, 240, 6,
162, 48, 169, 56, 208
4090 DATA  8, 173, 13, 207, 32, 37
, 205, 234, 234, 133
4100 DATA  253, 134, 251, 96, 32,
32, 39, 17, 39, 32
4110 DATA  61, 32, 17, 21, 9, 20,
32, 59, 32, 39
4120 DATA  49, 39, 32, 61, 32, 20,
 1, 16, 5, 32
4130 DATA  59, 32, 39, 56, 39, 32,
 61, 32, 4, 9
4140 DATA  19, 11, 32, 32  162, 40
, 189, 31, 204, 157
4150 DATA  183, 5, 169, 7, 157, 18
3, 217, 202, 208, 242
4160 DATA  96, 32, 2, 201  162, 40
, 189, 183, 5, 73
4170 DATA  128, 157, 183, 5, 202,
208, 245, 96, 0, 29
4180 DATA  29, 29, 69, 78, 84, 69,
 82, 32, 70, 73
4190 DATA  76, 69, 78, 65, 77, 69
 32, 65, 78, 68
4200 DATA  32, 80, 82, 69, 83  83,
 32, 39, 82, 69
4210 DATA  84, 85, 82, 78, 39, 13,
 13, 29, 29  29
4220 DATA  0, 70, 73, 76, 69, 78,
65, 77, 69, 32
4230 DATA  58, 32, 162, 13, 138, 3
2, 210, 255, 202, 208
4240 DATA  250, 189, 106, 204, 32
 210, 255, 232, 224, 54
4250 DATA  208, 245, 76, 59, 202,
32, 115, 205, 169, 0
4260 DATA  141, 32, 208, 141, 33,
208, 32, 239, 203, 32
4270 DATA  160, 204, 32, 72, 204,
234, 234, 234, 234, 234
4280 DATA  234, 234, 32, 159, 255,
 165, 197, 201, 62, 208
4290 DATA  3, 76, 252, 205, 201, 5
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4300 DATA  76, 243, 204, 201, 27,
240, 6, 32, 89, 204
4310 DATA  76, 210, 204, 169, 8, 1
41, 21, 207, 169, 1
4320 DATA  168, 174, 21, 207, 32,
186, 255, 173, 22, 207
4330 DATA  162, 32, 160, 207, 32
189, 255, 173, 20, 207
4340 DATA  208, 6, 32, 213, 255, 7
6, 32, 205, 32, 3
4350 DATA  204, 169, 250, 166, 252
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Program Listing II (cont.)

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 10, 24, 105, 48, 170
4370 DATA  105, 2, 96, 169, 0, 141
, 20, 207, 76, 183
4380 DATA  204, 169, 1, 208, 246,
173, 8, 207, 72, 173
4390 DATA  9, 207, 72, 32, 197, 20
0, 32, 158, 195, 104
4400 DATA  133, 253, 104, 133, 252
, 160, 0, 177, 252, 145
4410 DATA  250, 200, 192, 8, 208,
247, 76, 14, 201, 173
4420 DATA  141, 2, 41, 4, 208, 3,
76, 39, 206, 76
4430 DATA  22, 203, 173, 21, 208,
9, 2, 76, 17, 206
4440 DATA  76, 197, 200, 32, 90, 2
02, 169, 0, 133, 198
4450 DATA  76, 230, 193, 32, 230,
193, 169, 0, 133, 198
4460 DATA  104, 104, 76, 114, 202,
 169, 0, 141, 16, 208
4470 DATA  141, 21, 208, 141, 23,
208, 141, 29, 208, 32
4480 DATA  252, 197, 169, 13, 141,
 248, 7, 141, 249, 7
4490 DATA  169, 1, 141, 39, 208, 1
41, 40, 208, 169, 40
4500 DATA  141, 0, 208, 169, 66, 1
41, 1, 208, 169, 56
4510 DATA  141, 2, 208, 169, 146,
141, 3, 208, 234, 96
4520 DATA  234, 234, 234, 234, 234
, 234, 234, 234, 32, 186
4530 DATA  202, 32, 137, 205, 32,
33, 202, 162, 8, 189
4540 DATA  255, 47, 157, 239, 207,
 202, 208, 247, 32, 124
4550 DATA  192, 32, 76, 193, 32, 1
49, 199, 173, 21, 208
4560 DATA  41, 1, 141, 21, 208, 32
 232, 201, 32, 88
4570 DATA  194, 32, 2, 201, 32, 12
7, 198, 76, 229, 205
4580 DATA  169, 2, 133, 2, 160, 0,
 162, 0, 202, 208
4590 DATA  253, 136, 208, 248, 198
, 2, 208, 242, 76, 192
4600 DATA  205, 41, 2, 141, 21, 20
8, 76, 197, 200, 169
4610 DATA  0, 133, 170, 173, 141,
2, 41, 4, 133, 170
4620 DATA  76, 50, 206, 173, 21, 2
08, 41, 2, 141, 21
4630 DATA  208, 76, 57, 205, 169,
20, 141, 24, 208, 76
4640 DATA  53, 205, 169, 20, 141,
24, 208, 76, 45, 205
4650 DATA  3, 32, 8, 32, 1, 32, 18
, 32, 1, 32
4660 DATA  3, 32, 20, 32, 5, 32, 1
8, 32, 32, 7
4670 DATA  32, 5, 32, 14, 32, 5, 3
2, 18, 32, 1
4680 DATA  32, 20, 32, 15, 32, 18,
 32, 39, 54, 52
4690 DATA  16, 32, 18, 32, 5, 32,
19, 32, 19, 32
4700 DATA  32, 1, 32, 14, 32, 25,
32, 32, 11, 32
4710 DATA  5, 32, 25, 32, 32, 32,
20, 32, 15, 32
4720 DATA  32, 19, 32, 20, 32, 1,
32, 18, 32, 20
4730 DATA  169, 48, 141, 17, 207,
234, 234, 234, 169, 147
4740 DATA  32, 210, 255, 169, 142,
 32, 210, 255, 169, 8
4750 DATA  32, 210, 255, 169, 0, 1
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4760 DATA  208, 169, 64, 133, 197,
 162, 40, 189, 105, 206
4770 DATA  157, 183, 5, 169, 1, 15
7, 183, 217, 189, 65
4780 DATA  206, 157, 255, 3, 169,
7, 157, 255, 215, 202
4790 DATA  208, 231, 165, 197, 201
, 64, 240, 3, 76, 236
4800 DATA  206, 32, 89, 204, 162,
40, 189, 255, 3, 73
4810 DATA  128, 157, 255, 3, 202,
208, 245, 76, 208, 206
4820 DATA  173, 111, 201, 72, 208,
 3, 32, 254, 193, 104
4830 DATA  9, 1, 141, 111, 201, 23
4, 234, 76, 192, 205
4840 DATA  169, 1, 166, 2, 160, 1,
 32, 186, 255, 169
4850 DATA  7, 162, 35, 160, 207, 3
2, 189, 255, 169, 0
4860 DATA  133, 250, 169, 192, 133
, 251, 169, 250, 162, 0
4870 DATA  160, 207, 76, 216, 255,
 71, 69, 78, 39, 54
4880 DATA  52, 46, -1
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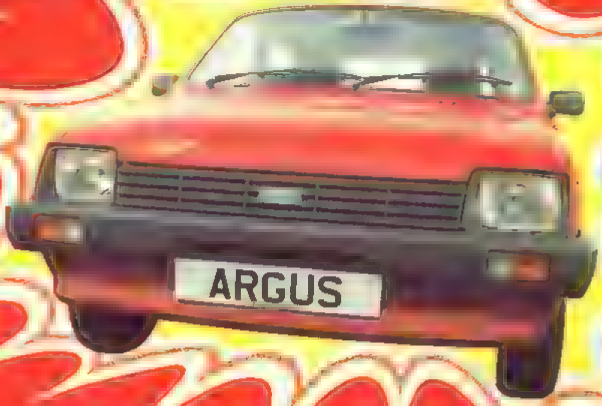

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RELIABLE ROUTINES

Mike Hart provides a couple of handy plotting routines for the Vic 20 and C64.

AT ONE TIME OR ANOTHER, MANY people must have experimented with their machines to see if there is an easy way to draw graphs or plots on the screen. There are three ways in which this can be done and I will call them low resolution, medium resolution and high resolution respectively.

In low-resolution plotting, one merely takes the screen as a grid and plot points using asterisks or a similar graphic characters. In the case of a C64 this would obviously be a grid of 40 × 25 giving 1000 potential plot points.

If one wished to use a high resolution screen then on the C64 one would use bit-mapped graphics which allows each individual 'dot' on the screen to be controlled. Using this mode will increase the resolution quite dramatically to 320 × 200 which is 64000 addressable dots. However using the C64 in this mode is quite complicated and needs to be approached with a degree of caution. The approach which I am going to adopt here is one that gives pleasant 'chunky' graphics points and is half-way between these two extremes and which, therefore, I shall call medium-resolution graphics.

If you were to PRINT CHR$(161), CHR$(188), CHR$(172) and CHR$(191) as a brief experiment you would see that a graphics character is generated which consists of a quarter square either by itself or in combination with another 'quarter-square' to make up a half square. There are 14 of these combinations altogether and together with space and reverse space we have a total of sixteen permutations of 'quarter-square' graphics. This enables us to make a resolution which is twice that of the normal screen and therefore instead of having 40 × 25 we can increase this to 80 × 50 giving us a resolution of 4000 plot points.

Let us suppose that we wish to plot a point at the bottom left hand corner of the screen. The complicating factor that we have to take into account is that there might already be a graphics character already occupying that position and we would wish to preserve the point that it represents. The trick here is to PEEK the screen at that particular point, read the value of the character at that point, look up its value in a table of potential values and then work out from the same table the value of the new character to be poked back onto the screen which both plots the 'new' point and the value of the existing point. If this is a little hard to visualise then any of Raeto West's books have an excellent explanation under the

Program Listing

MEDIUM-RES PLOT

```
1 REM  *** MEDIUM-RES PLOT (BASIC) ***
2 :
3 REM   **       M. C. HART          **
4 :
10 DIM C(15),A(1,1)
20 FORJ=0 TO 15:READ C(J):NEXT
30 DATA 32,123,108,98,126,97,127,252
40 DATA 124,255,225,254,226,236,251,160
50 :
60 A(0,0)=1:A(0,1)=2:A(1,0)=4:A(1,1)=8
70 :
80 :
90 :
100 FOR J=948 TO 969:READ X:POKE J,X:NEXT
110 DATA 32,241,183,138,162,0,157,0
111 REM DATA 32,241,215,138,162,0,157,0
120 DATA 216,157,0,217,157,0,218,157
121 REM DATA 148,157,0,149,157,0,150,157
130 DATA 0,219,202,208,241,96
131 REM DATA 0,151,202,208,241,96
140 :
300 PRINT CHR$(147);CHR$(144):REM BLACK
310 COL=0:REM BLACK
320 POKE53280,12:POKE53281,12:REM GREY2
321 REM VIC POKE 36879,25
330 :
340 SYS 948,COL:REM SET COLOUR MEMORY
350 FOR J=1 TO 2:FOR X=0 TO 79
351 REM VIC FOR J=1 TO 2:FOR X=0 TO 39
360 Y=22+21*SIN(X/8):GOSUB 1000
370 NEXT X:T=NOT(T):NEXT J
380 GOTO 2000
381 END: REM VIC ONLY
995 :
1000 REM PLOT SUBROUTINE
1010 :
1020 XL=INT(X/2):XS=X-2*XL
1030 YL=INT(Y/2):YS=INT(Y)-2*YL
1040 N=A(YS,XS)
1050 P=1984-40*YL+XL
1051 REM VIC 8K+ P=4580-22*YL+XL
1052 REM VIC<8K  P=8184-22*YL+XL
1060 FORI=0TO15:IF PEEK(P)<>C(I)THEN NEXT
1070 I=I OR N:IF T=-1 THEN I=I AND NOT(N)
1080 POKE P,C(I):RETURN
1090 :
2000 :
```

Program Listing

```
2001 REM *** MEDIUM-RES PLOT (MC)  ***
2002 REM
2003 REM  **  BY M. C. HART  **
2004 REM
2010 FOR J=828 TO 990:READ X:T=T+X
2020 POKEJ,X:NEXT:IF T=22553 THEN 3000
2030 PRINT "DATA ERROR!":END
2031 DATA 169,0,133,254,169,1,133,253
2032 DATA 165,251,201,80,176,56,165,252
2033 DATA 201,50,176,50,169,50,229,252
2034 DATA 70,251,38,254,106,38,254,133
2035 DATA 252,10,10,101,252,10,10,38
2036 DATA 253,10,38,253,234,234,234,133
2037 DATA 252,166,254,169,159,3,133,254
2038 DATA 164,251,177,252,162,15,221,163
2039 DATA 3,240,4,202,16,248,96,173
2040 DATA 158,3,240,6,138,5,254,170
2041 DATA 208,8,138,73,255,5,254,73
2042 DATA 255,170,169,163,3,164,251,145
2043 DATA 252,96,1,1,2,4,8,32
2044 DATA 126,123,97,124,226,255,236,108
2045 DATA 127,98,252,225,251,254,160,0
2046 DATA 32,241,183,138,162,0,157,0
2047 DATA 216,157,0,217,157,0,218,157
2048 DATA 0,219,202,208,241,96,32,235
2049 DATA 183,134,252,165,20,133,251,32
2050 DATA 241,183,142,158,3,32,180,3
2051 DATA 76,60,3
2060 :
3000 PLOT=970
3010 PRINT:INPUT"BACKGROUND";B
3020 PRINT:INPUT"PEN COLOUR";COL
3030 PRINT:INPUT"TWO NUMBERS E.G 2,3";X,Y
3040 POKE 53280,B:POKE 53281,B
3050 PRINT CHR$(147)
3060 :
4000 FORJ=1 TO 800
4010 SYS(PLOT)(1+SIN(X*J))*40,(1+COS(Y*J))*25,1,COL
4020 NEXT
4030 :
63000 REM SCREEN-DUMP
63010 :
63020 OPEN6,4,6:PRINT#6,CHR$(22):OPEN4,4
63030 FORI=0 TO 24:FOR J=0 TO 39
63040 A=PEEK(1024+I*40+J)
63050 GOSUB63100
63060 PRINT#4,A$;B$;C$;
63070 NEXTJ:PRINT#4:NEXTI
63080 PRINT#4:CLOSE4:END
63090 :
63100 A$="":B$="":C$=""
63110 IFA<=128 THEN 63130
63120 A$=CHR$(18):C$=CHR$(146):B$=CHR$(A-64):RETURN
63130 IF A<32 THEN A$=CHR$(A+64):RETURN
63140 IF A>31 AND A<64 THEN B$=CHR$(A):RETURN
63150 IFA >63 AND A<96 THEN B$=CHR$(A+128):RETURN
63160 B$=CHR$(A+64):RETURN
```

heading 'double density graphics' complete with diagrams and very full explanations of the manipulations involved.

Lines 1-1090 represent an implementation of medium-resolution graphics using BASIC only. This is fairly slow but is speeded up somewhat by making use of a machine code routine to poke the colour RAM so that we are not concerned with two POKEs for every point plotted. The program is given by default for the C64 but the changes needed for the VIC's are REMmed immediately after each of the affected lines.

Lines 10-60 are concerned with constructing a small 'look up' table.

Lines 100-140 read in the machine code for subsequent changes of colour RAM.

The main routine is in lines 300-380 which computes a sine curve and then plots it (on the first of the J loops) and then 'unplots' it (on the second of the J loops).

The procedure for VIC owners is to delete the following lines: 110,120,130, 320,350,380,1050. Now take the lines that immediately follow these i.e. 111,121,131, 321,351,381,1051-1052 and remove the REM portion of the statement that made these lines inoperative in the C64 version. You will also have to decide which version of VIC expansion you are operating with, as the screen shifts from $1E00 to $1000 just to make life confusing. Select either line 1051 or 1052.

Line 380 having been deleted makes the VIC version end in line 381.

Owners of the C64 now have a machine code version of the above which plots a Lissajous figure in the shape of a butterfly. An illustration of this is also given.

Lines 2000-2051 read the machine code into the cassette buffer. Then you are given a choice of background and pen colours (12 for background and 0 for pen colour i.e., black on light grey is my personal favourite).

PLOT is defined as 970 and this is the entry point.

Notice the complicated formula in line 4010 which actually follows the rubric SYS(PLOT) x,y,on/off, colour. The first computed value is obviously the x value whilst the second computed value is the y value. For a 'plot' we would then have a 1 and for an 'unplot' or 'erase' we would have a 0. Finally, we have the colour intended for the plot. You can obviously experiment with it as much as you like.

The origin is in the bottom left-hand corner (SYS(PLOT)0,0,1,0 whilst the opposite corner is SYS (PLOT)79,49,1,0).

Finally, lines 63000-63160 constitute a screen dump, written in BASIC but more than adequate.

TED CHIP

Nick Hampshire reveals the mysteries of the TED chip in the C-16 and Plus/4.

THE GRAPHICS DISPLAY SOUND GENeration and internal clock/timers of the C-16 and Plus/4 computers are controlled by a single integrated circuit, the so-called TED chip. This is a complex device, and, unfortunately, rather difficult to use.

An equally unfortunate circumstance is that no information on the use of this chip is provided in Commodore's manual. This is presumably in the belief that the graphics and sound commands supplied in the extended Basic are adequate. However, most advanced programmers, especially those writing machine code programs, will want direct access to the registers of this device.

The TED chip is a rather strange device. It is located in the middle of the kernal ROM area and overlays this ROM so that the ROM area covered by TED is inaccessible. In addition, the TED registers are not grouped in one continuous area of memory. We located TED registers in the area $FD00 to $FF3F. The reason for this is obscure and probably related to a quirk in the chip's design.

In operation the TED chip is not unlike the VIC and SID chips in the C64 and it is worth studying one of the advanced books on the 64 (for instance *Advanced Commodore 64 Graphics and Sound* and *The Commodore 64 Kernal and Hardware Revealed* – both by Nick Hampshire).

The following table shows the locations in TED which we have uncovered together with the function of each register and the bits within each location.

TED Graphics/Sound/Keyboard Control

FF00	— Timer 1 low
FF01	— Timer 1 high
FF02	Timer 2 low
FF03	— Timer 2 high
FF04	— Timer 3 low
FF05	— Timer 3 high
FF06	— Video control 1
Bit 7	Not used
6	1 = extended background
5	1 = Bit map
4	0 = blank screen
3	1 = 25 lines, 0=24 lines
2-0	Vertical smooth scroll pos
FF07	— Video control 2
Bit 7-5	Not used
4	1 = Multicolour
3	1 = 40 columns, 0 = 38 columns
2-0	Horizontal smooth scroll pos
FF08	— Out : keyboard column or joystick (FD or FA)
	In keyboard row or joystick switches
FF09	— Interrupt control
Bit 5	T3 has run out
4	T2 has run out
3	T1 has run out
1	Raster compare occurred
FF0A	— Interrupt enable
Bit 5	1 = T3 enable
4	1 = T2 enable
3	1 = T1 enable
1	1 = Raster enable
FF0B	— Raster compare low byte
FF0C	— Screen offset from base for cursor (high byte
FF0D	— Screen offset from base for cursor (low byte)
FF0E	— Voice 1 low byte
FF0F	— Voice 2 low byte
FF10	- Bits 1-0 Voice 2 high
FF11	— Sound control
Bit 7	Disable sound
6	1 = Noise on voice 2
5	1 Voice 2 tone enable
4	1 = Voice 1 enable
3-0	Volume (0-8 only)
FF12	
Bit 3	Bit map base
2	1 = chars from ROM 0=chars from RAM
1-0	Voice 1 high
FF13	- Character base address
Bit 7-3	Address of UDSC (2K steps)
2	1 =lower case
FF14	— Screen base address
Bit 7 3	Address of colour memory
	(2K steps, screen 1K above colour
FF15	— Background colour
Bit 7	Not used
6-4	Luminance (0-7)
3-0	Colour (0-15)
FF16	- Extended back 1/M col 1
Bit 7	Not used
6-4	Luminance (0-7)
3-0	Colour (0-15
FF17	— Extended back 2 M col 2
Bit 7	Not used
6-4	Luminance (0-7)
3-0	Colour (0-15)
FF18	— Extended back 3
Bit 7	Not used
6-4	Luminance (0-7)
3-0	Colour (0-15)
FF19	- Border colour
Bit 7	Not used
6-4	Luminance (0-7)
3-0	Colour (0-15)
FF1C	— Bit 0: Raster position high bit
FF1D	— Raster position low byte
FF3E	ROM in when written to
FF3F	— ROM out when written to
FD10	— Bit 2 cassette switch sense (0=down)
FF30-FD3F	— =no key, FF=key down

Scratchpad

A fistful of DATAs — more of your useful programming quickies presented by Max Phillips.

WELCOME TO THE PACE FOR YOUR programming bits and pieces. We're interested in anything, useful or amusing, from a few POKEs to a short utility and we'll pay for anything we use. Just send us your program (either as a listing or on cassette or disk) and some notes as to what it does and how it does it. Post your contributions to Scratchpad, Your Commodore, No 1 Golden Square, London W1R 3AB.

That '!'?! Bleepin Keyboard

Andreas Weinand kicks off this month with a machine code utility that produces a beep every time a key is pressed. It might be a help for anyone who has a dicky keyboard or can't manage two finger typing but watch out – it does mean everyone else can hear what your typing speed is like!

Andreas' program takes over the C64's regular interrupt and uses voice 1 on the SID chip to provide an expensive sounding beeper.

Clean Living

Wash is a handy disk utility supplied by Clifford Hanger of Manningtree in Essex. It lets you step through all the files on a disk one by one using the space bar. You can delete the current file by pressing S or rename it with R. Even better, pressing V lets you take a peek at what's in the file so you can figure out what it is and then scratch it if you don't need it.

The VIEW command works with all files though it cuts out any control characters and replaces them with full stops. Even so, you should be able to get a good idea of what the file is. One problem – after viewing a file, Wash sometimes goes back to the title of the disk – just hit space a few times to go round again. It just goes to show – you can write a useful utility in Basic.

Oh No, Not Again...

Printing at a particular position on the screen is still the most talked about subject in C64 programming. Graham Blighe of Eastleigh in Hampshire has pointed out that David Read's routine in Your 64 issue 13 won't let you print on the top line of the screen because you've got to POKE 214,Y-1 and then PRINT. Oh yes – I wondered when someone would spot that!

Graham has a neat solution – call the routine in the kernal ROM which recalculates the cursor position. The PRINT-AT routine then becomes

```
POKE 211,X POKE 214 Y SYS 58732
```

Meanwhile, Asmat Ullah from Glasgow has a friendlier clever machine code solution. It's only 12 bytes of code so it should be no trouble to include it in your initialisation section. Once loaded, you can print anywhere on the screen with

```
SYS 828)X Y "MESSAGE'
```

Neat, huh? Asmat does point out that there's no error checking in the routine in order to keep it short so you should make sure that X is less than or equal to 40 and Y is less than or equal to 25. Even so, it has to be the best yet. Unless, of course, you know different.

```
1 REM PRINT-AT ASMAT ULLAH
2 FOR X=828 TO 839 READ Y POKE
X Y NEXT
3 DATA 32,234,183,164,20,24,32,240,255,7
```

Clean Cut Characters

Paul Barnham of Darwen in Lancashire has sent in a delightful utility that replaces those hard to read control codes in listings with clear mnemonics such as [CLR9], [RED], [UP] and so on. Just enter POKE 56,15:CLR and run the listing below. You'll find LIST a changed command.

ANDREAS WEINAND LISTING

```
100 REM KEY BEEP BY ANDREAS WEINAND
110 REM START WITH SYS 832
120 FOR I=832 TO 940
130 READ X: POKE I,X: S=S+X: NEXT
140 DATA169, 15,141, 24,212,169, 64,141,
 5,212,169, 68
150 DATA141,  5,212,169, 69,162,157,141,
  1,212,142,  0
160 DATA212,169,100,162,  3,141, 20,  3,
142, 21,  3, 96
170 DATA165,203,201, 64,208,  3, 76, 49
234,162, 17,142
180 DATA  4,212,141, 87, 27,169 135,162,
  3,141, 20,  3
190 DATA142, 21,  3,169, 12,141, 86, 27,
 76, 49,234,169
200 DATA203,205, 87, 27,208, 12,174, 86,
 27,202,240,  6
210 DATA142, 86, 27, 76, 49,234,169,  0,
141,  4,212,169
220 DATA100,162,  3,141, 20,  3,142, 21,
  3, 76, 49,234
230 DATA 0
240 IF S<>11366 THEN PRINT "ERROR IN DAT
A":END
250 PRINT "OK"
```

CLIFFORD HANGER LISTING

```
10 REM DIRECTORY WASH  C HANGER 1985
20 PRINT "J";TAB(18),"%WASH%" PRINT
30 PRINT "    FOR CLEANER DIRECTORIES!"
40 REM READ DIR
50 OPEN2,8,15
60 OPEN 1,8,0,"$0"
70 GET#1,A$,B$
80 GET#1,A$,B$,A$,B$
90 C=0 IF A$<>"" THEN C=ASC(A$)
100 IF B$<>"" THEN C=C+ASC(B$)*256
110 C$=STR$(C) C$=LEFT$("     ",4-LEN(C$)
)+C$
120 GET#1,B$ IF ST<>0 THEN PRINT PRINT C
$ " BLOCKS FREE" CLOSE 1 GOTO60
130 IF B$<>CHR$(34) THEN 120
140 F$=""
150 GET#1,A$.IF A$<> CHR$(34) THEN F$=F$
+A$.GOTO 150
160 GET#1,A$ IF A$=" " THEN 160
170 T$=A$
180 GET#1,A$- IF A$<>"" THEN T$=T$+A$ GO
TO180
190 IF C=0 THEN PRINT PRINT "%TITLE% ",F
$ PRINT GOTO80
200 PRINT F$;TAB(18);"%BLKS%",C$;TAB(27)
,"%TYP% ",LEFT$(T$,3)
210 PRINT PRINT "%S%CRATCH %R%ENAME %V%I
```

```
EW ☒QUIT OR ☒SPACE■ ",
220 REM GET COMMAND
230 GET K$: IF K$="" THEN 230
240 PRINT K$ PRINT
250 IF K$="Q" OR K$="●" THEN CLOSE 1:PRI
NT"?":CLOSE 2 END
260 IF K$=" "THEN 300
270 IF K$="S" OR K$="◆" THEN PRINT#2,"S
"+F$,
280 IF K$="R" OR K$=" " THEN GOSUB330
290 IF K$="U" OR K$="↘" THEN GOSUB360:GO
TO200
300 IF ST=0 THEN80
310 CLOSE 1:CLOSE 2:END
320 REM RENAME FILE
330 INPUT"NEW NAME ";A$
340 IF A$="" THEN PRINT:RETURN
350 PRINT#2,"R:"+A$+"="+F$ PRINT:RETURN
360 REM VIEW FILE
370 PRINT PRINT"VIEWING ",F$
380 PRINT:PRINT"☒SPACE■ TO PAUSE, ☒A■ TO
 ABORT":PRINT
390 OPEN 5,8,5,"0:"+F$+","+LEFT$(T$,1)+"
,R"
400 GET#5,A$: IF ST=0 THEN 430
410 CLOSE 5 POKE 144,0
420 PRINT:PRINT"☒FILE ENDS■" PRINT RETUR
N
430 IF A$<>"" THEN A$=CHR$(ASC(A$)AND 12
7):IF A$<CHR$(32) THEN A$="."
440 PRINTA$,
450 GETK$:IF PS=1 AND K$="" THEN 450
460 IF K$=" " THEN PS=ABS(1-PS)
470 IF K$<>"A" AND K$<> "◆" THEN 400
480 CLOSE 5 POKE 144,0
490 PRINT:PRINT"☒ABORTED■":PRINT PRINT:R
ETURN
```

PAUL BARHAM LISTING

```
10 FORX=0TO217.READA T=T+A POKE40704+X,A
 NEXT
15 IFT=25486THENSYS40704:END
17 PRINT"ERROR" STOP
20 DATA169,11,141,6,3,169,159,141
30 DATA7,3,96,133,251,72,138,72,152
40 DATA72,164,15,192,1,240,23,162,0
50 DATA189,89,159,197,251,240,24,232,232
60 DATA232,232,189,89,159,201,0,240,3
70 DATA76,29,159,104,168,104,170,104,165
80 DATA251,76,26,167,169,91,32,71,171
90 DATA232,189,89,159,48,3,76,59,159
100 DATA41,127,32,71,171,169,93,32,71
110 DATA171,104,168,104,170,104,76,0,167
120 DATA19,72,79,205,147,67,76,210,144
130 DATA66,76,203,5,87,72,212,28,82
140 DATA69,196,159,67,89,206,156,80,85
150 DATA210,30,71,82,206,31,66,76,213
160 DATA158,89,69,204,145,85,208,98,17
170 DATA88,206,88,29,82,71,212,157,76
180 DATA71,212,133,70,177,88,134,70,179
190 DATA88,135,70,181,88,136,70,183,88
200 DATA137,70,178,88,138,70,180,88,139
210 DATA70,182,88,140,70,184,88,18,82
220 DATA79,206,146,82,79,198,129,79,82
230 DATA199,149,66,82,206,150,76,82,196
240 DATA151,71,82,177,152,71,82,178,153
250 DATA76,71,210,154,76,66,204,155,71
260 DATA82,179,0
```

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